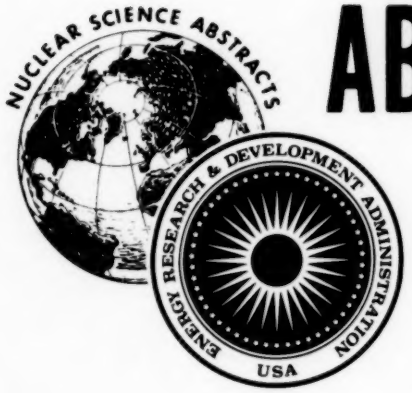
NUCLEAR SCIENCE ABSTRACTS



Volume 31 Number 12

Abstracts 32461-35724

June 30, 1975

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ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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NOTICE

A title page for Volume 31, Numbers 7–12, is included at the back of this issue for use in binding those issues.

CORRECTIONS

NSA Vol. 31, No. 5, Abst. 10967, line 1 should read: (UCRL-75975) PLASMA DEVELOPMENT IN LOW Z

NSA Vol. 31, No. 6, Abst. 13798, line 1 should read: PRODUCTION OF HIPPURAN-^{131}I AT BORIS KIDRIC

NSA Vol. 31, No. 6, Abst. 14123, line 1 should read: (EGG-1183-2307) CHARACTERIZATION EFFORT OF

NSA Vol. 31, No. 6, Abst. 14123, line 6 should read: Oct 1974. 21p. (CONF-741213-1). Dep. NTIS $4.25.

NSA Vol. 31, No. 6, Abst. 15400, line 2 should read: LEVEL DENSITIES IN THE A = 130 TO 200. Pshenichnyi, V. A.

NSA Vol. 31, No. 6, Abst. 15824, line 1 should read: (UCID-30001(Rev. 3)) GEAR: ORDINARY DIFFER-

NSA Vol. 31, No. 7, Abst. 16399, line 1 should read: (SAND-74-0359) SATURABLE ABSORBERS. Jones,

NSA Vol. 31, No. 7, Abst. 18882, line 1 should read: (RN-S-0528(Vol. 2)(Bk. 1)) 75K NERVA ENGINE SYSTEM ANALY-

Volume 31, Number 12, June 30, 1975

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USERDA Office of Public Affairs
Published by the ERDA Technical Information Center

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Energy Research and Development Administration and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

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CARTER, G., See REED, D.J., 30:21824
CASA, A.F., Nuclear energy in Japan,
    30:23243
CASARETT, A.P., See KALLFELZ, F.A.,
    30:21411
CASCI, C., Method for preliminary
    analysis of MHD generator
    performance, 30:20916 (AGARD-CP-
    104)
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  Optimization of control-rod programming in multiregion
    nuclear reactors, 30:23184
REACTOR COOLING SYSTEMS/TRANSIENTS
  WFLASH:  a FORTRAN-IV computer program for simulation of
    transients in a multi-loop PWR, 30:23171 (WCAP-
    8261(Rev.1))
REACTOR CORES/INSPECTION
  Initial results of a holographic tomosynthesis technique
    for fuel-core inspection, 30:23198
REACTOR CORES/STRESS ANALYSIS
  Methods of stress analysis in use at General Atomic for
    core design (HTGR graphite moderator), 30:23078 (GA-A-
    12870)
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23214 (HEDL-TME-74-16) ANALYSIS OF TEMPERATURE PROFILES IN TRANSIENTLY HEATED UO_2 USING MOLYBDENUM INCLUSIONS. Wilmot, E. L. **(Hanford Engineering Development Lab., Richland, Wash. (USA)).** [nd]. Contract AT(45-1)-2170. 23p. AT.

is indexed as:

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HANFORD ENGINEERING DEVELOPMENT LAB., RICHLAND, WASH. (USA)
  Analysis of temperature profiles in transiently heated
    UO2 using molybdenum inclusions, 30:23214 (HEDL-TME-74-
    16)
  HEDL quarterly technical report, January--March 1974.
    Volume I.  Materials technology, 30:21815 (HEDL-TME-74-
    1(Vol.1))
  Modeling of the post-irradiation fuel-cladding gap in
    mixed-oxide fuels, 30:23103 (HEDL-TME-74-19)
  Preliminary data report:  post-irradiation examination of
    fuel pins PNL-10-23 and PNL-10-63, 30:23149 (HEDL-TME-
    74-23)
  Prototype applications loop two years of operation,
    30:20928 (HEDL-TME-74-24)
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Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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Volume 31, Number 12 June 30, 1975

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

32461 (HASL-291, pp I.38-I.56) ANALYTICAL CONSIDERATIONS CONNECTED WITH THE TRANSURANIUM ELEMENTS. Wessman, R. A.; Lee, K. D.; Major, W. J.; Leventhal, L. (LFE Environmental Analysis Labs., Richmond, CA). 1 Apr 1975.

In Health and Safety Laboratory environmental quarterly, December 1, 1974 – March 1, 1975.

The analysis of the transuranium elements (Pu, Np, Am, Cm and Cf) in environmental samples is limited by a lack of well established procedures, particularly for Np, Cm and Cf. Factors influencing the choice of processing steps are the sample matrice, available tracers, the multiplicity of nuclides to be determined, the radiation measurement method to be used and analytical costs. These factors are discussed and illustrated with emphasis on the methodology used at this laboratory in past years as well as recently. The techniques are now rapidly changing to meet the individual analytical problems which arise and to optimize the procedures and minimize costs. The status of procedures for various sample matrices and possible future analytical needs is discussed. (auth)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 33234, 33639, and 34892.

32462 (ERDA-tr-8) DETERMINING SILVER CONTENT ACCORDING TO THE SHORT-LIVED ISOMER ^{110}Ag IN THE PNEUMATIC RABBIT OF THE VVRK REACTOR USING THE Ge(Li)- SPECTROMETER. Burmistrov, V. R.; Shilin, V. A. Translated from Prikl. Yadern. Spektrosk.; No. 3, 33-42(1972). 24p. Dep. NTIS $4.25.

Monomineral samples of lead sulfide, zinc sulfide, as well as concentrates of iron sulfide, copper sulfide, zinc sulfide, lead sulfide, or combinations of sulfides of the Akzhalskiy, Dzhezkazgan, Zyryanovsk, Irtysh, and Tishinsk deposits were used in the study to develop the method for measuring the silver content by the ^{110}Ag short-lived isomer. Ores that were used included polymetallic dense ore, polymetallic large-granule ore, copper pyrite impregnated ore, fine-grained dense ore, and large-granular impregnated ores of the Zyryanovsk, Irtysh, Nikolaev, and Ridder-Sokol'nii deposits. Sensitivity of the method that was developed is 10^{-3} to 10^{-5}%. (LK)

32463 (KFK-2053) DETERMINING THE COMPONENT DISTRIBUTION IN MIXED SPUN YARNS BY MEANS OF ACTIVATION ANALYSIS. Kirschner, E.; Vogg, H. (Kernforschungszentrum Karlsruhe (F. R. Germany)). 1974. 6p. (In German). INIS.

Published in Chemiefasern Text.-Ind. (1974) v. 24/76 p. 359-362/493-495.

Lanthanum at a level of 0.2% was added as inactive tracer to the PES part of a mixed spun yarn PES/viscose 70 : 30% in the primary spinning, after various spinning arrangements yarns were spun, samples taken from those and these were subdivided into 2m yarn sections. Irradiation of the latter was done with pneumatic tubes in the coiler plate of the thermal column of the Karlsruhe research reactor (FR 2) at a neutron flux density of 3×10^{11} cm^{-2} s^{-1}. The radioactivity from ^{140}La measured after decay of the faulty matrix was a measure for the PES part at that time. Other materials, present from the start in the fiber, prove to be unsuitable as activable tracers substances due to their non-guaranteed homogeneous distribution. The neutron activation analysis method is very suitable for the determination of the component distribution in mixed spun yarns. It achieves measuring accuracies of less than 1% and costs about three times less than the chemical analysis method. The time saved is at least a factor of 2. The technical problems applied to the textile technical task consisted in determining the influence of doubling and mixed methods on the component distribution of the mixed spun yarn. (GE)

32464 (LBL-2852) SINGLE ATOM IMAGING IN HIGH RESOLUTION ELECTRON MICROSCOPY. Chiu, W. (California Univ., Berkeley (USA). Donner Lab.). Jan 1975. Contract W-7405-eng-48. 106p. Dep. NTIS $8.50.

Thesis.

The present work is concerned with theoretical studies of atom image contrast and of atom movement, and also with an experimental method for single atom specimen preparation and calibration in high resolution electron microscopy. Single atom image intensities are calculated for the case of bright field, including the single side band aperture, and for various dark field modes, including the ideal beam stop, a wire beam stop, titled illumination and a displaced aperture. Comparisons of scattering amplitudes and elastic scattering cross section are made with different object potentials and scattering formulations. The image contrast for one mercury atom on a column of carbon atoms as the substrate is also discussed. The probability of atom movement as a result of thermal motion and knock-on scattering has been estimated. The effects of atom binding energy and the specimen temperature on thermal motion, and the effects of binding energy and incident electron energy on knock-on scattering are also discussed. Finally, an experimental method is presented for preparing a single atom specimen composed of a low density of gold atoms ($< 3 \times 10^{-10}$ gm/cm^2) between two ultra-thin carbon films, which may be suitable for a definitive confirmation of single atom images. The capability and accuracy of neutron activation analysis to calibrate the density of the gold atoms in the specimen has also been demonstrated. (auth)

32465 (LYCEN-T-74-12) THIN SOLID FILM ANALYSIS AND CONCENTRATION PROFILE OBTENTION USING CHARGED PARTICLE BOMBARDMENT IN THE ENERGY RANGE UP TO 4 MeV. Thomas, J.-P. (Lyon-1 Univ., 69 – Villeurbanne (France). Inst. de Physique Nucleaire; Lyon-1 Univ., 69 (France)). 1974. 96p. (In French). INIS.

Methods using direct observation of radiations induced by charged-particle reactions at low energy (500 keV-4 MeV) are particularly adapted to the elementary analysis of surfaces. They can be used for thin-film characterization but also apply to the nondestructive determination of concentration profiles at depths up to one hundred microns. However, many analytical problems are encountered outside typical application areas. Nondestructive determination of deep profiles (approximately 50 μm) were obtained for fluorine in dental enamel by detecting prompt gamma radiations of the ^{19}F(p,$\alpha\gamma$) reaction and using special irradiation set-ups (air irradiation). This can be considered as an application of a "global" method, the principles of which being discussed through the validity conditions of the equation systems obtained. Oxygen and carbon analysis in boron matrix is made possible with a coincidence detection system of the charged particles emitted in the ^{16}O(p,p) and ^{12}C(d,p) reactions. This procedure allows concentration profiles to be obtained on a few micron depth, with an acceptable depth resolution. Mathematical treatment of the spectra is discussed in the most general case. Such an analytical method appears as a valuable tool for the study of boron purification procedures like vacuum

fusion process. Proton-induced x-ray fluorescence allows simultaneous determination of medium and heavy impurities in boron thin films. New datas are so gained through the evolution of such impurities, the films being obtained at different steps of the evaporation process. Improvement of the method sensitivity is proposed, based on the anisotropy of the target-induced bremsstrahlung. Some examples of thin-film stoichiometry determination are given (like for aluminium nitride) as an illustration of the ability of the nuclear methods to solve the film characterization problems. (FR)

32466 CONTRIBUTION TO THE METHODS OF SAMPLE PREPARATION FOR GOLD DETERMINATION BY INSTRUMENTAL ACTIVATION ANALYSIS. Schiller, P.; Skalova, A. (Ustav Experimentalni Mineralogie a Geochemie CSAV, Prague). Radioisotopy; 16: No. 1, 149-158(1975). (In Czech).

The problem of errors due to the composition and properties of the sample is considered. Work reported was concerned with the comparison of gold analysis results obtained by homogenization with methanol and those obtained with non-homogenized samples. Nondestructive activation analysis was used for the proper determination of gold; the samples were irradiated for 20 minutes in the reactor with a flux of $2 \times 10^{13} n/cm^2 \cdot s$ and the spectrum was measured with a 1024-channel spectrometer with a Ge(Li) detector. The obtained results, however, did not confirm unambiguously the advantage of the methanol homogenization claimed by the author. The F-test calculations have shown no statistically significant difference in the standard deviations of both methods. The most important factor of the homogeneous distribution of the trace element is apparently the proper grain size depending on the milling and screening process and on the amount of the sample taken for analysis. (auth)

32467 ACTIVATION ANALYSIS. Toelgyessy, J. pp 51-291 of Nuclear Analytical Chemistry. III. Toelgyessy, J. (ed.). Bratislava, Czechoslovakia; VEDA, Publishing House of the Slovak Academy of Sciences (1974).

The principles of activation analysis are outlined, as are sample and standard preparations, and neutron activation, charged-particle activation and gamma activation are dealt with. The transport of samples after activation, activity measurements, the processing of samples are discussed. Destructive and nondestructive activation analysis, and applications are dealt with. (INIS)

32468 RADIOCHEMICAL ANALYSIS. Varga, S. pp 15-50 of Nuclear Analytical Chemistry. III. Toelgyessy, J. (ed.). Bratislava, Czechoslovakia; VEDA, Publishing House of the Slovak Academy of Sciences (1974).

The occurrence of radionuclides in the living environment is outlined as well as the preparation of samples for radiochemical analysis and the principles of radiochemical methods. The determination of T, P, Sr, Zr, Nb, Ru, I, Cs, Ba, Ce, Po, Ra, Th, U, Pu, and of rare earths is described. (INIS)

32469 DETERMINATION OF HAFNIUM IN ZIRCONIUM AND ZIRCALOY BY NEUTRON ACTIVATION AND EXTRACTION CHROMATOGRAPHY. Yonezawa, C.; Tamura, N.; Onishi, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jap. Anal.; 23: No. 7, 764-768(Jul 1974). (In Japanese).

Extraction-chromatographic separation of hafnium from zirconium was effected by using cyclohexanone adsorbed on polytrifluoromonochloroethylene (Daiflon) particles as a stationary phase and ammonium thiocyanate–ammonium sulfate–hydrochloric acid as a mobile phase. This separation method was applied to the determination, by neutron activation, of 0.5 to 200 ppM of hafnium in zirconium and Zircaloy using ^{181}Hf ($T_{\frac{1}{2}}$ = 42.5 days) produced by the reaction $^{180}Hf(n,\gamma)^{181}Hf$. The procedure is as follows: A sample (5 ~ 100 mg) and portions of standard solution (Hf 0.005 ~ 0.1 μg, 1 ~ 10 μg) were irradiated in JRR-2 at a thermal neutron flux of about 2×10^{13} n/cm² · sec for 290 hr or at a flux of 7×10^{13} for 20 min. After irradiation the sample and standard solutions were cooled to allow decay of short-lived radionuclides. The sample was dissolved in sulfuric acid–ammonium sulfate. Zirconium plus hafnium was precipitated with ammonium hydroxide and then dissolved in hydrochloric acid. The hydrochloric acid concentration was adjusted to 6M, and ^{95}Nb was removed by extraction with α-benzoinoxime in chloroform. The aqueous solution was evaporated to dryness on a water bath, and then converted to 3M ammonium thiocyanate–1.5M ammonium sulfate–1.2M hydrochloric acid solution. Daiflon, which adsorbed cyclohexanone, was packed in glass columns (8φ × 300 mm each) and conditioned with 3M ammonium thiocyanate–1.5M ammonium sulfate–1.2M hydrochloric acid previously shaken with cyclohexanone. The sample solution was transferred to the column and the column was washed with 35 ml of 3M ammonium thiocyanate–1.5M ammonium sulfate–1.2M hydrochloric acid shaken with cyclohexanone. Hafnium-181 was retained on the column but ^{95}Zr passed through. Hafnium-181 was eluted with 25 ml of 2M sulfuric acid shaken with cyclohexanone. Ten ml of the effluent was transferred to a polyethylene vial, and γ-radioactivity of ^{181}Hf was measured. A calibration curve was prepared by adding 60 mg of zirconium to the irradiated standard hafnium solutions and treating them in the same way as the samples. If 2 mmol of fluoride or 4.5 mmol of sulfuric acid was present in the sample solution, the separation on the column was unsuccessful. An average recovery of ^{181}Hf was 93%, and decontamination factor of ^{95}Zr was 4×10^4. Radionuclides produced from zirconium and Zircaloy did not interfere with the determination of hafnium. Hafnium in zirconium metal, zirconium oxide and standard Zircaloy samples was determined by using the above-mentioned procedure, and satisfactory results were obtained. (auth)

32470 ANALYTICAL COMPARISON OF VARIOUS EGYPTIAN SOILS, CLAYS, SHALES, AND SOME ANCIENT POTTERY BY NEUTRON ACTIVATION. Tobia, S. K. (Univ., Cairo); Sayre, E. V. pp 99-128 of Recent Advances in Science and Technology of Materials. Vol. III. Bishay, A. (ed.). New York; Plenum Publishing Corp. ([nd]).

In a number of archaeological studies it has been possible to correlate the pattern of trace impurities in ancient pottery to that in clay from probable sources of the pottery. With such correlation in mind, samples of clay, mud and shale, which might have been used in ancient pottery, from twenty sites throughout Egypt were analyzed for sixteen elements by thermal neutron activation. Although Nile mud was found to be virtually indistinguishable in composition no matter where along the course of the river in Egypt a sample was taken, other types of pottery forming materials showed considerable variation in composition. From two sites, Kharga Oasis-Gabel Abu Tartour and the El Sharawana district, extensive sampling of twelve and seven layers respectively of exposed shales spanning some hundreds of meters of total deposition depth, were sampled. An unexpected degree of correlation between surface samples taken from different deposition layers at the same site suggests that chemical exchange occurring during weathering may have tended to distribute trace impurities somewhat uniformly through the exposed layers. Nine specimens of ancient Egyptian pottery ranging in date from Old Kingdom to early Coptic were compared to each other and to the Egyptian clays analytically. (auth)

32471 NEUTRON ACTIVATION ANALYSIS OF SHORT-LIVED NUCLIDES BY PULSE AND STEADY STATE IRRADIATION. Determination of Lead Via 0.8 s ^{207m}Pb. Menke, H.; Weber, M. (Mainz Univ. (F.R. Germany). Inst. fuer Kernchemie); Leszczynski, C. (Bundeskriminalamt, Wiesbaden (F.R. Germany). Kriminaltechnisches Inst.). Z. Anal. Chem.; 272: No. 5, 337-340(Dec 1974). (In German).

The only useful nuclide for neutron activation of lead (e.g., gunshot traces) is the 0.8-s ^{207m}Pb. Therefore, using a fast pneumatic transfer system, the sensitivities obtainable in steady state and pulse irradiation in a nuclear reactor were investigated. It turned out that under ideal conditions 1 μg lead is still easily measurable, whereas for steady state irradiation a sensitivity of 50 μg lead was found. However, for the samples to be investigated the dead-time caused by the matrix effected a shift of this relation in such a way that the sensitivity for steady state and pulse irradiation was about 100 μg lead. (auth)

32472 THE USE OF Ge(Li) DETECTORS IN ACTIVATION ANALYSIS OF ROCKS, ORES AND MINERALS. Zajtsev, E. I.; Sotskov, Yu. P. (AN SSSR, Moscow. Inst. Mineralogii, Geokhimii i Kristallokhimii Redkikh Ehlementov); Reznikov, R. S. (Moskovskoe Mezhoblastnoe Otdelenie Vsesoyuznogo Obshchestva Izotop (USSR)). Izotopy SSSR; No. 32, 35-42(1973). (In Russian).

Consideration is given to the possibilities of using activation analysis on minerals by means of commercially available Ge(Li)-detectors of the type DGD and DGDK. Data are presented on the sensitivity, selectivity, and also the economic efficiency of the method. (tr-auth)

32473 NEUTRON ACTIVITY RECONNAISSANCE FOR DETECTING TUNGSTEN- AND MOLYBDENUM DEPOSITS. Gorbachev, A. N.; Karpunin, A. M.; Matukanic, L. F. (Vsesoyuznyj Inst. Razvedochnoj geofiziki, Leningrad. (USSR)). Sov. Geol.; No. 9, 146-149(1973). (In Russian).

The practical possibilities of using a new express field method of fluorometric, neutron-activation surveying are demonstrated for the purpose of searching and finding tungsten and molybdenum deposits in the Dzhidinskii mineral field. The very high, search-find efficiency of the fluorometric, neutron-activation surveying is established. (tr-auth)

32474 COMBINED NUCLEAR GEOPHYSICS LOGGING TECHNIQUES TO DETERMINE COPPER CONTENT IN WELLS. Bakhterev, V. V.; Sen'ko-Bulatnyj, I. N. (AN SSSR, Sverdlovsk.

Inst. Geologii i Geokhimii). Razved. Okhr. Nedr; No. 2, 39-43 (1974). (In Russian).

Results are presented of studies on perfecting methods of determining the copper content in borehole cross-sections by combined nuclear-geophysical survey methods. The combination of neutron activation measurements and selective gamma-gamma surveying increases the reliability of determining the copper content. (tr-auth)

32475 COMPARISON BETWEEN DELAYED AND PROMPT NEUTRON ACTIVATION ANALYSIS AND USE OF PROMPT NEUTRON ACTIVATION ANALYSIS IN MEDICINE. Yaghubian, R. (Oesterreichische Studiengesellschaft fuer Atomenergie, Seibersdorf). pp 273-281 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German)

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Possible application of prompt neutron activation analysis (N.A.A.) in biological problems is examined, and the advantages and disadvantages of prompt N.A.A. compared with conventional (delayed) N.A.A. are discussed. As an example, boron and cadmium were measured. The high cross-section of these elements for thermal neutrons permits their exact measurement in biological samples by prompt N.A.A. The method is applicable to in vivo measurements since the elements need not be chemically separated. Prompt γ rays with energies 477 keV and 559 keV resulting from the reactions $^{10}B(n,\alpha)^{7}Li$ and $^{113}Cd(n,\gamma)^{114}Cd$ were detected with a Ge(Li) detector and, after amplification, registered in a TMC 16384 4096 channel analyzer. The samples were irradiated for 60 minutes in the Astra reactor of the Reaktorzentrum Seibersdorf and measured simultaneously. The accumulated data were stored on a DIANA tape and analyzed on an IBM 1130 computer. The measured values and the limits of detection of these elements, as well as the possibilities of improving the sensitivity of the method, are discussed in detail. (auth)

32476 STUDY OF TRACE ELEMENT DISTRIBUTION IN HUMAN BONE USING NEUTRON ACTIVATION ANALYSIS. Behne, D.; Braetter, P.; Keller, C.; Roesick, U. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). pp 475-480 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German)

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

The uptake of various trace elements by human bone has been studied in the tibia using neutron activation analysis. Ag, Co, Cr, Cs, Fe, Rb, Sb, Sc, Se, and Zn were measured in both mineral and collagen fractions. All elements studied except Zn showed considerable variations in their concentrations along the length of the bone. Scandium and Zn were present predominantly in the mineral whereas the other elements were equally distributed between the inorganic and organic phases. (auth)

32477 DETERMINATION OF OXYGEN IN ZIRCALOY SURFACES BY MEANS OF CHARGED PARTICLE ACTIVATION ANALYSIS. Lorenzen, J.; Brune, D. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Nucl. Instrum. Methods; 123: No. 2, 379-384(15 Jan 1975).

Oxygen in zircaloy surfaces was determined by means of charged particle activation analysis employing the following two reactions: I $^{16}O(d,n_0)^{17}F \xrightarrow{\beta^+} {}^{17}O$, Q = -1.63 MeV; II $^{16}O(d,p_{1Y})^{17}O^*$, Q = +1.05 MeV. The detection limits for oxygen in such surfaces was investigated by measuring the promptly emitted 0.87-MeV gamma rays (reaction II) and also the 511 keV annihilation radiation which arises from β^+ -decay of ^{17}F (reaction I). The correlation between the detection limit for oxygen in zircaloy, the particle energy, and the surface thickness analyzed was evaluated. At a deuteron energy of 3 MeV a detection limit of 0.7×10^{-7} g/cm^2 was obtained from the measurement of the prompt gamma radiation arising from the second of these reactions. The analysis carried out by means of this technique is characterized by a high degree of rapidity. (auth)

32478 SIMPLE NEUTRON ACTIVATION METHOD FOR THE DETERMINATION OF MOLYBDENUM IN PLANTS. Singh, B. R.; Steinnes, E. (Institutt for Atomenergi, Kjeller, Norway). Soil Sci. Soc. Amer., Proc.; 39: No. 2, 370-371(1975).

A neutron activation method was developed to determine molybdenum in plants. After wet-ashing of the irradiated samples, the induced ^{99}Mo activity was adsorbed on anion exchange resin from H_2SO_4/H_2O_2 solution. The separation of molybdenum is quantitative, while interfering activities are efficiently removed. The precision of the method is about 5% at the 1 ppm level. (auth)

32479 DETERMINATION OF MOLYBDENUM BY EPITHERMAL NEUTRON ACTIVATION ANALYSIS IN THE PRESENCE OF URANIUM USING HIGH RESOLUTION GAMMA RAY SPECTROMETRY. Lavi, N.; Fishelson, Z. (Israel Atomic Energy Commission, Yavne. Isotope Applications Dept.). Radiochim. Acta; 20: No. 1/2, 93-95(1973).

The accuracy of the activation analysis for molybdenum is decreased in the presence of uranium as the activation product isotope ^{99}Mo is also formed by the uranium fission. The ratio of naturally activated molybdenum to fission-produced ^{99}Mo can be considerably increased by using epithermal neutron activation, which is demonstrated here by the example of artificial U/Mo mixtures. (GE)

32480 DETERMINATION OF TRACE IMPURITIES IN HIGH PURITY LATETIUM OXIDE BY NEUTRON ACTIVATION WITH AID OF CATION-EXCHANGE SEPARATION. Kubota, M. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). J. Nucl. Sci. Technol. (Tokyo); 11: No. 8, 334-338(Aug 1974).

Trace impurities including Yb in commercially available Lu_2O_3 of high purity were determined by neutron activation followed by cation-exchange separation with α-hydroxyisobutyrate. After irradiation in reactor, the Lu_2O_3, together with about the same quantity of Yb carrier, was dissolved in HCl, and fed to a cation-exchange resin column. Lutetium, Yb, Tm, and some other rare earths were eluted successively, using α-hydroxyisobutyrate and citrate solutions as eluants. The addition of Yb carrier facilitated the analysis of Yb which is difficult to separate from Lu, and this permitted the determination of Yb of quantities as small as a few ppM. The impurities found present in this sample of Lu_2O_3 were: 0.26 ppM Sc, 395 ppM Yb, 150 ppM Tm, 12 ppM Tb and 2.3 ppM Eu. (auth)

32481 ACTIVATION ANALYSIS OF RUTHENIUM. Terada, K. (Kanazawa Univ. (Japan). Faculty of Science). Kagaku No Ryoiki; 28: No. 4, 306-312(Apr 1974). (In Japanese).

Nuclear reactions, troublesome interference reactions, radiochemical separation, and practical examples of measurement are reviewed with emphasis on the activation analysis of ruthenium. A Ge(Li) semiconductor should be used to detect photoelectric peaks of ^{103}Ru, if the radioactivity from its sources is sufficiently strong. G. M. counting may be the most accurate measurement for radiochemically separated samples. Coincidence counting method may not be used in the case of ^{103m}Ru, a daughter nucleus of ^{103}Ru, because its half-value period is too long. The interference caused by the nuclear fission reaction of $^{235}U(n,f)^{103}Ru$ and $^{235}U(n,f)^{105}Ru$ and by the primarily induced radioactivity due to the (n,p) or (n,α) reaction of other coexisting elements of platinum family is one of the interference problems. Ruthenium should be separated from samples before irradiation in order to eliminate the interference. In order to eliminate the error due to the self-shielding of thermal neutrons by solid samples, standard addition process is practicable for compensating the difference of matrices. Distillation, solvent extraction, and ion exchange may be employed as the process for separating ruthenium accurately. There is no report on the determination of ruthenium by fast neutron activation analysis. The method of the activation analysis by photonuclear reaction limits the range of samples considerably. (JA)

32482 ACTIVATION ANALYSIS OF ENVIRONMENTAL POLLUTANTS. Mamuro, T. (Radiation Center of Osaka Prefecture, Sakai (Japan)). Radioisotopes (Tokyo); 23: No. 6, 355-363(Jun 1974). (In Japanese).

Radiochemical analysis for environmental pollutants were classified according to the sample for analysis and were introduced. On the analysis of air suspended particulate matters in industrial zones, the analysis of environmental water samples, the analysis of vital samples and food in biology, medicine, and agriculture, and the analysis of soil pollution performed in relation to the pollution of farm produce, sampling, treatment of samples, the application of instrumental neutron activation analysis, seasonal changes, pursuit of the source of pollution, and the elemental composition according to grain size were introduced. (JA)

32483 14 MeV NEUTRON ACTIVATION ANALYSIS WITH LOOPED SAMPLE IRRADIATION METHOD. Application for Aqueous Solution. Tsuji, H.; Fujiwara, Y.; Kusaka, Y. (Konan Univ., Kobe (Japan). Faculty of Science). Jap. Anal.; 23: No. 7, 776-790(Jul 1974). (In Japanese).

Activation analysis with a looped sample irradiation system using 14 MeV neutrons was studied theoretically and experimentally. The variation of induced activity for various elements with flow rate in the system were computed by theoretical calculations. From the results shown in the figure, the optimum flow rate and the relative sensitivity for analysis were determined. Experimental studies were carried out on $^{19}F(n,p)^{19}O$, $^{23}Na(n,\alpha)^{20}F$, $^{28}Si(n,p)^{28}Al$, $^{31}P(n,\alpha)^{28}Al$ and $^{52}Cr(n,p)^{52}V$. In the experiments, one

litre of aqueous sample solution, containing potassium fluoride, sodium nitrate, potassium silicate, dipotassium hydrogenphosphate, or potassium chromate, was poured in the sample reservoir and recirculated with various flow rate. Irradiation with 14 MeV neutrons produced by T-d reaction and measurement of gamma-ray spectrum with a 3 in × 3 in NaI(Tl) detector connecting to a multichannel P.H.A. were carried out for 5 min. Relative neutron intensities during the experimental period were monitored with a neutron scintillator (NE-213) connected to a pulse-shape discriminator and a scaler. The photopeak intensities in the gamma-ray spectra were measured and normalized with the integrated counts of the neutron monitor to the standard neutron counts (8×10^5 counts per 5 min). The gamma-ray spectra are shown in the figure, as well as the results of the photopeak intensity variations with the flow rate. The optimum flow rate and the analytical sensitivity for each element are shown. In an aqueous sample solution, inteference of ^{16}N produced from the matrix oxygen becomes a limiting factor in the selection of the experimental conditions. Therefore, a consideration on the SN ratio, as shown in the figure, is necessary in the selection. As a practical application, the analytical results of sodium in sea water is shown. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 32935, 33137, 33169, and 33378.

32484 (CEA-CONF-2692) RECENT DEVELOPMENTS IN PLUTONIUM ANALYSIS. Regnaud, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). Nov 1973. 14p. (In French). (CONF-740486-1). Dep. NTIS (US Sales Only) $4.00.

From 3rd French-Spanish colloquium; Marcoul, France (25 Apr 1974).

The development of the analytical chemistry of Pu has followed three directions in recent years: high precision analysis, atomic absorption analysis, and x-ray fluorescence analysis. The term "precision analysis" implies exactitude of analysis and reproducibility. The techniques developed in each of these three analytical areas at Saclay are outlined. In precision analysis oxydoreduction titration gives a precision between 0.05 and 0.1% for the determination of Pu in metal and mixed oxides from fast neutron reactors. With atomic absorption 10^{-6} to 10^{-7} g of Pu can be determined. An x-ray fluorescence installation was developed for the determination of Pu and U in reprocessing solutions. The techniques followed in each of these determinations are briefly outlined. (JSR)

32485 (CEA-N-1670) METHODS OF BORON DETERMINATION APPLIED TO THE FOEHN EXPERIMENT. Bacou, C.; Msika, D.; Cray, J.; Genetay, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. de Physique des Reacteurs et de Mathematiques Appliquees). Jun 1974. 45p. (In French). INIS.

In the frame of the FOEHN experiment (set up on the High Flux Reactor in Grenoble) boron is used either as homogeneous solution or as solid state allied to aluminium. The solution allows the simulation of great reactivity variations due to the fuel burn-up. As solid state, the boron will balance a part of the potential reactivity of the reactor core flux (tip effects). The method developed for the boron solution determination needs neither particularly clever experiments nor precise knowledge of the possibilities of the apparatus. An almost industrial experience has shown its simple and reliable aspects. The measurement precision (at 95% probability) has an average of ±0.4% but automation of the method should allow down to ±0.2%. For the fixed boron determination the precision should be less than ±2% (at 68% probability). (FR)

32486 SCANDIUM, YTTRIUM, LANTHANIDE, AND ACTINIDE ELEMENTS. Dallmann, W. E.; Fassel, V. A. (Iowa State Univ., Ames). pp 631-672 of Determination of Gaseous Elements in Metals. Melnick, L.; Lewis, L.; Holt, B. New York; John Wiley and Sons, Inc. (1974).

Methods of measuring nonmetallic impurities (O, N, and H) in metals are reviewed. Subtopics include: (1) metallurgical aspects; (2) historical development; (3) standard samples; (4) sampling and sample preparation; (5) analysis; and (6) recommended procedures. Sc, Y, and La are included in the treatment of the rare earths, while the actinides are primarily limited to the metals which have been prepared in quantity (Th, U, and Pu). (PMA)

32487 DIRECT COLORIMETRIC DETERMINATION OF RARE EARTH TRACE IN ALLOY STEELS BY DICARBOXYARSENAZO III. Kuan, T. C.; Lo, M. C. (Wuhan Univ., China). Hua Hseuh Tung Pao; No. 5, 26-29(23 Sep 1974).

Development of a fast, direct colorimetric method for the determination of traces of rare earth elements from 0.020-0.20% in alloy steels is reported. Dicarboxyarsenazo III (DCAA III) is used as the coloring agent, and EDTA-zinc diethyl ester is used as the masking agent to mask ferric, aluminum, chromic, titanium, and cuprous ions. Following a description of the apparatus and procedure, the RE-DCAA III complex absorption, the influence of pH, temperature, iron content, and interferences, the quantity of buffer, EDTA ethyl ester, zinc acetate and coloring agent to be used, and the stability of the rare earth-DCAA III complexes are discussed. (JPRS)

32488 SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM(VI) WITH BROMOPYROGALLOL RED AND ZEPHIRAMINE. Deguchi, M.; Iizuka, M. (Hiroshima Univ. (Japan). Faculty of Engineering); Yashiki, M. Jap. Anal.; 23: No. 7, 760-764(Jul 1974). (In Japanese).

Molybdenum formed a water-soluble blue complex with Bromopyrogallol Red(BPR) in the presence of excess zephiramine in an acidic medium containing hydrochloric acid. The absorption maximum of the BPR-molybdenum-zephiramine complex was at around 629 nm, and the absorbance was maximum at 0.16 to 0.24M HCl solution (the acidity of the final solution). The absorbance of the complex reached its maximum in 15 minutes, and did not change at all for 1 hour at least. The calibration curve followed Beer's law over the range from 2 to 25 μg of molybdenum in 25 ml solution. The molar absorptivity was 55600 at 629 nm. The sensitivity was 0.0017 μg molybdenum/cm² for the absorbance of 0.001. The coefficient of variation of the absorbance for 20 μg of molybdenum was 0.73%. The molar ratio of molybdenum to BPR in the complex was estimated to be 1:1 by the continuous variation method. The proposed method was sensitive and selective, and its sensitivity was superior to the Pyrocatechol Violet-cetyltrimethylammonium bromide method, but inferior to Pyrogallol Red-dodecanol trimethylammonium bromide method and to Pyrocatechol Violet-dialkylmonomethylbenzylammonium chloride method. The recommended analytical procedure is described. A sample solution containing 2 to 25 μg of molybdenum was taken into a 25 ml volumetric flask. Suitable amounts of 1N hydrochloric acid, 1.5 ml of 10^{-2}M zephiramine and 1.0 ml of 0.03% BPR were added to it, and the mixed solution was made up to 25 ml with water (the final acidity 0.16 to 0.24N). After 20 minutes, the colored solution was poured into a 1 cm cell and the absorbance was measured at 629 nm against a reagent blank. The effect of 33 kinds of diverse ions on the absorbance of the complex was examined. Many kinds of diverse ions did not interfere with the determination, but antimony(III), iron(III), tin(IV), zirconium(IV), hafnium(IV), vanadium(V), chromium(VI), and tungsten(VI) interfered even in the same amount as the molybdenum. The permissible amount of these interfering ions could be increased by addition of some masking agents such as 0.05M EDTA, 1% L-ascorbic acid and 20 w/v% ammonium fluoride. However, tungsten(VI) was not masked by those masking agents. The proposed method was applied to the determination of molybdenum in steel samples (except the sample containing tungsten). The analytical results of standard samples of steel by the proposed method were in good agreement with standard value of those samples. (auth)

32489 ENERGY DISPERSIVE X-RAY SPECTROMETRIC ANALYSIS. Koch, S. (Technische Universitaet, Dresden). Isotopenpraxis; 10: No. 11-12, 385-390(1974). (In German).

The development and principles of x-ray spectral analysis are summarized in a review of the present status of the technique. Energy dispersive analysis in the macro and micro ranges is discussed from the viewpoint of its applicability and limitations. Energy dispersive powder diffractometry is briefly described and a typical spectrum obtained from an Al powder is given. (38 references) (JSR)

32490 VERSIONS OF ENERGY DISPERSIVE X-RAY EMISSION ANALYSIS. II. Choice of Excitation and Detection Conditions. Thuemmel, H. W. (Zentralinstitut fuer Isotopen- und Strahlenforschung, Leipzig). Isotopenpraxis; 11: No. 2, 41-49(Feb 1975). (In German).

The principles for the optimization of measurement conditions are discussed with a consideration of model equations and measurement sensitivity, measurement errors, and factors affecting the analysis errors. Measurement geometries are described for technical sources such as heavy particle accelerators, electron beam devices, and x-ray tubes and for radionuclides radiation sources. (46 references) (JSR)

32491 EXTRACTION-SPECTROPHOTOMETRIC DETERMINATION OF DI(2-ETHYLHEXYL)-PHOSPHORIC ACID WITH RHODAMINE B. Bhattacharyya, K.; Murthy, T. K. S. (Bhabha Atomic Research Centre, Bombay (India). Chemical Engineering Div.). Anal. Chim. Acta; 71: No. 1, 107-111(Jul 1974).

A spectrophotometric method for the determination of traces of bis(2-ethylhexyl)phosphoric acid (DEHPA) in raffinates from solvent extraction processes is described. The two types of aqueous solutions considered are sulfate leach liquors from uranium ores, and wet-process phosphoric acid (6M) that originally contained

uranium. The method is based on the formation of a strongly colored ion-pair between the rhodamine B cation and the DEHPA anion in 1,2-dichloroethane. DEHPA is extracted from the aqueous solution by dichloroethane, and the organic layer is contacted with an aqueous solution containing rhodamine B and phosphate buffer pH 4. The effective molar absorptivity of the colored complex is about 75,000. (INIS)

32492 SPECTROPHOTOMETRIC STUDIES ON THE REDUCTION OF VANADIUM AND MOLYBDENUM BY GLUCOSE AND FRUCTOSE. Pandey, L. P. (National Metallurgical Lab., Jamshedpur (India)). NML (Nat. Met. Lab.) Tech. J. (Jamshedpur, India); 15: 24-27(Feb 1973).

Reduction of vanadium and molybdenum with glucose and fructose was studied spectrophotometrically. It was observed that D-fructose reduces vanadium and molybdenum faster than D-glucose. The optimum pH of vanadium reduction is 1 whereas for molybdenum reduction it is 1.5. Very high or very low H^+ concentration reduces the reduction rate in both the cases. (auth)

32493 USE OF PHOTOLUMINESCENCE OF CRYSTALLOPHOSPHORS FOR THE DETERMINATION OF MICROAMOUNTS OF NEPTUNIUM. Novikov, Yu. P.; Anikina, L. I.; Ivanova, S. A.; Karyakin, A. V.; Myasoedov, B. F. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Radiochem. Radioanal. Lett.; 20: No. 6, 339-345(20 Mar 1975).

The determination of microamounts of neptunium by luminescence radiation in the infra-red region of $PbMoO_4$ crystallophosphors activated by neptunium is proposed. The lower limit of neptunium detection is 5×10^{-9} g/m. (auth)

32494 STUDY AND ANALYTICAL USE OF COMPLEXES OF CERIUM(III) WITH OXYETHYLIDENEDIPHOSPHORIC ACID AND S-BENZYLTHIOURIC ACID. Kirillov, A. I.; Turkina, L. A.; Vlasov, N. A. (Irkutsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 18: No. 3, 381-383(1975). (In Russian).

It was established that oxyethylidendiphosphoric acid (OPA) forms with Ce (III) a binary complex with the ratio Ce:OPA = 1:2 and in the presence of S-benzylthiouric acid (BTA) a ternary complex is formed with the ratio Ce:OPA:BTA = 1:2:4. The ternary complex is quite soluble in butyl, isobutyl, amyl, isoamyl, and hexyl alcohols. An extraction-spectrophotometric method was developed for the determination of Ce in the presence of all the rare earths of the Y subgroup. The small determinable quantity of Ce (III) is 0.5 μg/ml. (tr-auth)

32495 IMPLICATIONS IN THE USE OF SECONDARY ION MASS SPECTROMETRY TO INVESTIGATE IMPURITY CONCENTRATION PROFILES IN SOLIDS. Schulz, F.; Wittmaack, K.; Maul, J. (Gesellschaft fuer Strahlen und Umweltforschung mbH, Munich). pp 23-27 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F.R. Germany (24 Sep 1972). See CONF-7209125-.

Using a recently developed high-sensitivity secondary-ion mass spectrometer, the influence of the sputtering ion energy (5 to 50 keV argon) on the original range distribution was investigated with a standard implantation profile as a reference (20-keV boron in amorphous silicon). It was found that recoil processes change the distribution only in the long range tail so that projected range and standard deviation are not influenced by this effect within the limits of experimental accuracy. Because of the low sputtering yield of silicon ($S \lesssim 2$ atoms/ion), however, there is a change in sputtering rate at the beginning of layer removal until equilibrium between implantation and release of argon is obtained. This effect results in an increase in the measured value of the projected range which can be corrected by extrapolation to zero sputtering energy (R_p = 690 Å, ΔR_p = 280 Å). Neither scanning electron microscopy nor talysurf measurements showed any indication for the development of a surface topography after sputtering silicon layers up to 5000 Å in thickness. (5 fig) (auth)

32496 SURFACE STUDY BY APPLICATION OF NOBLE GAS ION BACKSCATTERING TECHNIQUE. Akaishi, K. (Univ., Nagoya, Japan). pp 135-137 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F.R. Germany (24 Sep 1972). See CONF-7209125-.

A simply designed noble gas ion scattering system enclosed in a Pyrex glass container was constructed. This was used to study sorption characteristics of the residual gases (H_2O; CO, ... etc.) in the glass system or CO gas on the bare or Pd-coated, Ni surface. In the scattering experiments, the contaminated states by the active gases of these surfaces could be known from observation of the scattered He ions peak by oxygen atoms. In the case of gold-coated Ni surface, the active gas adsorption was depressed and only the Au peak was detected. (5 fig) (auth)

32497 APPLICATION OF CHARACTERISTIC SECONDARY ION MASS SPECTRA TO A DEPTH ANALYSIS OF COPPER OXIDE ON COPPER. Werner, H. W.; de Grefte, H. A. M.; van den Berg, J. (Philips Research Labs., Eindhoven, Netherlands). pp 305-309 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F.R. Germany (24 Sep 1972). See CONF-7209125-.

The study of molecular and cluster ions in secondary ion mass spectrometry has led to the concept of characteristic (fingerprint) spectra for this mode of ionization. Thin films of copper oxide with decreasing oxygen concentration as a function of depth have been investigated. The dependence of all mass peaks as a function of depth can be calculated from the measured values of just one peak by means of a linear superposition of the characteristic mass spectra of copper oxide and copper. Finally it is shown that the concentration of copper and copper oxide as a function of depth can be calculated from any mass peak when using the appropriate fingerprint spectra. (auth)

32498 EXTRACTION AND PHOTOMETRIC DETERMINATION OF URANIUM (VI) WITH N-p-TOLYLBENZOHYDROXAMIC ACID (p-TBHA). Agrawal, Y. K. (Government Polytechnic, Ujjain, India). Anal. Lett.; 8: No. 4, 257-267(Apr 1975).

A rapid method for the simultaneous solvent extraction and spectrophotometric determination of hexavalent uranium with N-p-tolylbenzohydroxamic acid is described. The intense red complex with uranium can be extracted by chloroform at pH ~ 4.3. The red colored complex obeys Beer's law at 515 nm. A satisfactory separation from many commonly occurring metal ions is easily accomplished. Effects of acidity, reagent concentration and diverse ions on the visible absorption spectrum of the extracted complex have also been investigated. (auth)

32499 SODIUM N-BENZOYL-O-SULPHONATE-N-PHENYLHYDROXYLAMINE AS SPECTROPHOTOMETRIC REAGENT FOR MOLYBDENUM (VI). Bharagava, S. C.; Sogani, N. C. (Rajasthan Univ., Jaipur (India). Dept. of Chemistry). Indian J. Appl. Chem.; 35: No. 4, 131-132(1972).

Sodium N-benzoyl-o-sulfonate-N-phenyl hydroxylamine was prepared from sulfobenzoic anhydride, phenylhydroxylamine and sodium hydroxide and was investigated as a spectrophotometric reagent for determination of molybdenum (VI). The optimum conditions for formation of molybdenum complex with the reagent were established and a procedure for the best results is recommended. It prescribes molybdenum solution containing 300 to 1400 μg of the metal, pH range between 2.5 to 4.0 at 1:90 ratio of the metal to the reagent and absorbance measurement at 390 nm using water as a blank, 20 minutes after the solution is prepared. Interference of diverse metal ions was also studied. 7 Refs. (INIS)

32500 DETERMINATION OF URANIUM IN FRESH WATER, SEDIMENTS, AND BIOLOGICAL MATERIALS. Hanusova, J.; Havlik, B. (Institut Hygieny a Epidemiologie, Prague (Czechoslovakia)). Cesk. Hyg.; 19: No. 5, 227-234(Jun 1974). (In Czech).

Photometric determination of uranium in samples of fresh water, sediments, and biological materials is described. The determination is based on the reaction of U(IV) (after reduction with zinc and ascorbic acid) with Arsenazo III. The formed blue-green complex is photometrically measured at 665 nm (red filter). If suitable cuvettes (5 cm width) are used, the lower sensitivity threshold of the method is 1 μg of uranium. (59 Refs.) (auth)

32501 SPECTROPHOTOMETRIC DETERMINATION OF MICRO-AMOUNTS OF URANIUM (VI) AND THORIUM (IV) WITH DITHIZONE. Malik, W. U. (Roorkee Univ. (India). Dept. of Civil Engineering); Sharma, T. C. (Gurukul Kangri Univ., Hardwar (India). Dept. of Chemistry). Indian J. Appl. Chem.; 35: No. 4, 147-148(1972).

Uranyl complexes and thorium complexes with dithizone were prepared and studied spectrophotometrically with a view to assess suitability of dithizone as a reagent for colorimetric estimation of uranium and thorium. The complexes obey Beer's law. Uranium and thorium in quantities as low as 1 ppM can be determined. The molar composition of the complexes shows that it contains metal and dithizone in the molar ratio 1:2. Interferences by a large number of added foreign ions have been studied and tolerance limit determined. (5 Refs., 1 Table, 2 Figures) (INIS)

32502 USE OF MUON X RAYS FOR ELEMENT ANALYSIS OF TISSUES IN VIVO. Preliminary Experimentation on Bone.

Kellershohn, C.; Comar, D.; Sejourne, C. (Hospital d'Orsay, France). pp 465-474 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In French)

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-470120--.

The use of muonic x rays (μ^-) for the in vivo analysis of tissues such as bone is described. μ^- resulting from the disintegration of negative pions (π^-) produced in a linear accelerator were used to produce muonic x-ray spectra from bovine costal bone. K-lines of carbon, nitrogen, oxygen, phosphorus, and calcium were demonstrated. Preliminary results are encouraging and may have advantages over neutron activation analysis. (auth)

32503 STUDIES ON SPECTROCHEMICAL ANALYSIS OF RARE EARTH ELEMENTS. Osumi, Y. (Government Industrial Research Inst., Osaka, Ikeda (Japan)). Osaka Kogyo Gijutsu Shikensho Hokoku; No. 345, 1-123(Mar 1974). (In Japanese).

Solution-excitation and power-excitation methods were studied for the emission-spectrometric determination of traces of rare earth and non-rare earth elements in high purity rare earth compounds. As for solution-excitation method (in part II), the fundamental conditions for emission-spectrometric analysis incorporating a rotating electrode (chapter 2) and a vacuum cup electrode (chapter 3) were investigated. Effects of organic solvents (chapter 4) and alkali elements (chapter 5) on the line intensity in the emission-spectrometric analysis incorporating a rotating electrode were investigated. Effects of alkali elements on the axial distribution of line intensity in plasma of high voltage spark were investigated, and the role of cesium to achieve optimum sensitivity and good precision in the spark excitation–spectrometric analysis of rare earth compounds incorporating a rotating electrode was explained. Based on the above fundamental study, the emission-spectrometric method for the determination of trace amounts of the elements in cerium, neodymium, and samarium compounds incorporating a rotating electrode using methanol (chapter 7), and in lanthanum, neodymium, europium, and yttrium oxides using cesium chloride were investigated. As for power-excitation method (in part IV), the fundamental conditions for emission-spectrometric analysis using AgF–Ga_2O_3 carrier (chapter 2) and CsCl–graphite buffer (chapter 3) were investigated. Based on the fundamental study, the following proposed methods were investigated: the emission-spectrometric method for the determination of trace amount of non-rare earth elements in yttrium oxide using AgF–Ga_2O_3 (1 : 2) carrier (chapter 4) and rare earths and non-rare earth elements in neodymium, samarium, europium, gadolinium, and yttrium oxides using CsCl–graphite buffer (chapter 5); the combined solvent extraction–spectrochemical method for the determination of trace amounts of non-rare earth elements in cerium dioxides (chapter 6); the emission-spectrometric method for the determination of trace amounts of rare earth elements in glass samples. (JA)

32504 EXTRACTION OF TELLURIUM WITH TRI-N-OCTYLAMINE AND ITS APPLICATION. Suzuki, T.; Sotobayashi, T.; Koyama, S. (Niigata Univ. (Japan). Faculty of Science). Jap. Anal.; 23: No. 9, 999-1004(Sep 1974). (In Japanese).

The liquid-liquid extractions of tellurium (IV, VI) from hydrochloric, hydrobromic, and hydroiodic acid solutions with a 5 vol % tri-n-octylamine solution in xylene were investigated. The extractability of tellurium (IV) from each acid solution increased in the following order: hydrochloric acid < hydrobromic acid < hydroiodic acid. Instead of unstable hydroiodic acid solution, sodium iodide solution containing perchloric acid or sulfuric acid was used for the separation of tellurium(IV). Complete extraction of tellurium(IV) was achieved by the pair of solutions which gave a final concentration of 0.1 M sodium iodide and 0.2 M perchloric acid. Tellurium(IV) extracted with the tri-n-octylamine was hardly back-extracted into acid solutions, but quantitatively into 1 N ammonium hydroxide solution. The method was successfully utilized to the separation of radioactive tellurium in the fallout. A new method was also developed for the colorimetric determination of tellurium(IV) using the high molecular weight amine. The method was based on the extraction of tellurium(IV) with a 1 vol % tri-n-octylamine solution in benzene from 2 N hydrobromic acid solution, followed by the direct photometry of the organic phase at 452 nm. Beer's law was obeyed and the molar absorptivity was 4300. Hydrochloric, nitric, and sulfuric acid do not interfere with the tellurium(IV) determination. Iron (III) was extracted in the organic phase together with tellurium(IV) under these conditions, but trace of iron(III) was removed by washing the organic phase with a 2 N hydrobromic acid solution. The extracted species of tellurium(IV) from hydrobromic or hydroiodic acid solutions were examined. The results indicated that the ratio of amine to tellurium(IV) was 2 : 1 in the extracted species obtained from both acid solutions. Possible formulation for these extracted species was: $(R_3NH)_2TeX_6$ in which X = Br or I, and R = C_8H_{17}. (auth)

32505 ACCURATE DETERMINATION OF THE D_2O CONTENT OF HEAVY WATER. Babeliowsky, T.; de Bolle, W. E. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Metrologia; 10: No. 4, 129-136(Nov 1974).

The D_2O content of heavy water was determined by mass spectrometric analysis of deuterium gas samples which had been brought into equilibrium with samples of the water. Through use of careful sample handling and preparation, application of corrections, and a calibration procedure, the accuracy of the results was improved to ± 0.001 mole % D_2O for reactor grade heavy water. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 33188, 33189, 33229, 33248, 33539, 33600, 33601, 34460, and 34461.

32506 (AERE-R-7944) X-RAY PHOTOELECTRON AUGER SPECTROSCOPIC ANALYSES OF STEEL SURFACES. Coad, J. P. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jan 1975. 12p. Dep. NTIS (US Sales Only) $4.00. HMSO 50 pence.

XPS was used in combination with AES to examine oxide films on steel and to study fracture surfaces. The use of XPS is shown to lead to valuable extra chemical information and reduced incident beam effects. Important results on the direct observation of reversibility of grain boundary segregation are reported. (auth)

32507 (BNWL-1950(Pt.2), pp 153-156) RADIOANALYTICAL PROCEDURES DEVELOPMENT. Dec 1974.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological Sciences.

A procedure for measuring uranium, thorium, radium, plutonium, and americium in soil samples is described. Procedures for rapid radiochemical separation of the following neutron activation products are given: ^{94m}Nb, ^{52}V, ^{99}Mo, ^{64}Cu, and ^{198}Au. (LK)

32508 (HASL-291, pp I.127-I.144) ANALYSIS OF ENVIRONMENTAL SAMPLES FROM THE MOUND LABORATORY AREA. Progress Report. Volchok, H. L. 1 Apr 1975.

In Health and Safety Laboratory environmental quarterly, December 1 1974–March 1, 1975.

All of the available analytical results from the 8 sediment cores and 16 water samples obtained from water bodies in the vicinity of Mound Laboratory during July 1974, are reported here. These include ^{238}Pu in both sediment and water, ^{241}Am in sediment and ^{3}H in water. The quality of these analyses was found to be acceptable with the exception of an approximately 30% bias in the accuracy of the ^{238}Pu data. (auth)

32509 (LA-5867-MS) IN VIVO TISSUE ANALYSIS USING MU-MESIC X RAYS. Hutson, R. L. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-eng-36. 9p. Dep. NTIS $4.00.

The energies of the mu-mesic x rays emitted when negative muons are captured by atoms of the various elements in tissue are characteristic of the particular element. The yields of x rays can then be used as a measure of the amount of the various elements in the tissue. The x-ray spectra from animal tissues show clearly the spectral series from carbon, nitrogen, and oxygen. (auth)

32510 STATISTICS OF LOW LEVEL COUNTING. Low Level Counting of ^{3}H and ^{14}C. Saro, S. (Komenskeho Univerzita, Bratislava (Czechoslovakia). Prirodovedecka Fakulta). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; No. 13, 131-143 (1973).

Principal laws of statistics in low-level counting are given. Expressions were derived for the minimum counting time necessary, for the minimum observable counting rate, and for the maximum age measurable by radiocarbon dating. The appropriateness of various units in expressing the specific tritium activity of water is discussed. (auth)

32511 CONCENTRATION OF THE NATURAL ISOTOPE POLONIUM-210 IN SOME BONES OF CATTLE. Smirnova, A. P. Sb. Rab., Leningrad. Vet. Inst.; No. 33, 285-288(1973). (In Russian).

The most sensitive method for the determination of ^{210}Pb is based on the isolation from samples and measurement of the alpha-activity of ^{210}Po. Practical studies on the determination of ^{210}Po in biological samples are complicated by the need for ashing with acid oxidants. Polonium-210 was isolated from the

samples by electrochemical deposition on a nickel foil plate. (Ref. zh)

32512 PROPERTIES OF ^{41}Ca AND ITS APPLICATION IN GEOCHRONOLOGY. Sitar, B. (Komenskeho Univerzita, Bratislava (Czechoslovakia). Prirodovedecka Fakulta). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; No. 13, 233-249 (1973). (In Slovak).

The occurrence of calcium in the lithosphere and the formation of ^{41}Ca isotopes in nature are described. Experimental results are listed of the detection of low-energy radiation of the ^{41}Ca K capture, $A = 4.457 \times 10^{-12}$ Ci, in conditions deteriorated by the presence of the ^{45}Ca isotope of high activity. Measurements were carried out using a proportional counter filled with the 40% CH_4 + 60% Ar mixture, at a pressure of 800 torr. Emitters having an energy approaching that of the ^{41}Ca isotope K capture were used for calibration. The method described may be applied in the measurement of ^{41}Ca activity in natural samples. (INIS)

32513 RADIOMETRIC ASSAY OF SULPHUR-35 IN BIOLOGICAL MATERIAL BY MEANS OF LIQUID SCINTILLATION COUNTING. De Villiers, J. F.; Deist, J.; Haasbroek, F. J. (Fruit and Food Technology Research Inst., Stellenbosch (South Africa)). Agrochemophysica; 6: 31-34(1974).

With summary in Afrikaans and French.

A method for the routine analysis of ^{35}S by means of liquid scintillation counting is described. Sulphur compounds are oxidized to sulphate, which is then precipitated as calcium sulphate in an alcohol medium directly for counting as such. It compares favorably with a universal scintillator system and efficiencies of 85% are obtained. (INIS)

32514 DETECTION OF ^{26}Al IN NATURAL SAMPLES. Sitar, B.; Chrapan, J. (Komenskeho Univerzita, Bratislava (Czechoslovakia). Prirodovedecka Fakulta). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; No. 13, 227-232(1973). (In Slovak).

Results obtained by various authors in measuring natural samples for ^{26}Al activity are surveyed showing different values for different samples. It is suggested that the scatter of values is due to the combination of different ways of activation and to various ages of the samples. (INIS)

32515 APPLICATION OF X-RAY ANALYSIS IN MEDICINE. Kubo, H. (Kitasato Univ. (Japan). School of Medicine). Kitasato Igaku.; 4: No. 3, 207-213(Jun 1974). (In Japanese).

A strong need and practice of physics knowledge has recently been emphasized by various professional researchers in medical fields and a practical use of x-ray fluorescence analysis is proposed for trace elemental analysis in biological tissue samples. In particular, a possibility of trace elemental analysis of liver samples is examined for the future investigations using the data obtained earlier by a similar method. (auth)

32516 USE OF A Si(Li) SEMICONDUCTOR DETECTOR FOR TRACE ELEMENT ANALYSIS IN HUMAN TISSUE SAMPLES. Kubo, H.; Hashimoto, S. (Kitasato Univ., Sagami, Kanagawa (Japan). School of Medicine); Chiba, R.; Nakamura, H. Radioisotopes (Tokyo); 23: No. 8, 450-454(Aug 1974). (In Japanese).

The results of proton induced x-ray fluorescence analysis are reported. The beam was obtained from a 4-MeV van de Graaff accelerator of the Tokyo Institute of Technology. Methods utilized to prepare samples, to extract absolute trace element concentrations, and so on are described. The following human liver tissue sections were selected in determining metal concentrations; acute myelocytic leukemia, hepatitis, cirrhosis, and hepatoma. As a result, Cu and Zn levels were found to be rather constant among these diseases; however, Fe concentration considerably decreased in the case of hepatoma. (auth)

32517 TRITIUM IN NATURE. 2. Experimental Equipment for Low Tritium Activity Measurements. Povinec, P.; Chudy, M.; Saro, S. (Komenskeho Univerzita, Bratislava (Czechoslovakia). Prirodovedecka Fakulta). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; No. 13, 277-288(1973).

Described is the equipment, including proportional counters, for low tritium activity measurement. The minimum measurable tritium activity after 24 hours of counting is 40 TU ± 10%. The liquid scintillation method of tritium counting is described using dioxane-naphthalene-water system. The method makes it possible to measure activities higher than 110 TU without isotope enrichment. With electrolytic enrichment both proportional counters and the liquid scintillation methods may be used in measuring activities higher than 1 TU. (auth)

32518 MEASUREMENT OF ASH CONTENT IN COAL BY REGISTERING FORWARD-SCATTERED-GAMMA-RADIATION FROM SELENIUM-75. Rudanovskij, A. A.; Vasil'ev, A. G.; Onishchenko, A. M. Izv. Vyssh. Ucheb. Zaved., Gorn. Zh.; No. 8, 147-151(1973). (In Russian).

A control coal sample is placed in a cylindrical cuvette made of 3-mm-thick Plexiglass. A SI-22G counter is used as a radiation detector. A lead filter-plug is placed on a line between the source and the detector. Artificially prepared mixtures were used to determine the count rate as a function of layer thickness for coals having different ash contents, and determinations were made of the sensitivity of the method to ash content, moisture, and content of pyrites in the coal ash. An estimate was made of the average, square deviation of the measurement result because of separate interfering factors: equipment error, variations in layer thickness, humidity, space factor and pyrites content in the ash. The corresponding estimates are compared with the method of controlling the coal ash from the absorption of ^{241}Am and ^{75}Se gamma-radiation, and with the method using ^{241}Am. (tr-auth)

32519 STABILIZATION OF THE BACKGROUND LEVEL IN X-RAY RADIOMETRIC ANALYSIS OF COMPLEX ORES. Medvedev, Yu. S.; Ochkur, A. P.; Leman, E. P. (Nauchno-Proizvodstvennoe Ob edinenie, Leningrad, Geofizika, (USSR)). Geofiz. App.; No. 53, 112-116(1973). (In Russian).

A theoretical and experimental study is carried out on stabilization of the background level on investigating ores of complex composition containing an interfering element whose characteristic radiation is excited simultaneously with that of the element to be determined. A condition is obtained for selecting the energy region of the internal standard in the secondary gamma-spectrum, the observance of which assures stabilization of the background level while realizing the method of spectral ratios independent of changes in the material composition of interfering ores. (tr-auth)

32520 X-RAY RADIOMETRIC ANALYSIS OF ROCKS IN POLYMETAL DEPOSITS. Kozlov, G. G.; Zhuravlev, G. L.; Przhiyalgovskij, S. M. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Okhrany Truda, Moscow (USSR)). Razved. Okhr. Nedr; No. 2, 43-46(1974). (In Russian).

X-ray radiometric testing of rock samples is carried out on metal deposits in the Northern Caucasus. (tr-auth)

32521 PROTON-INDUCED X-RAY ANALYSIS OF STEEL SURFACES FOR MICROPROBE PURPOSES. Ahlberg, M.; Akselsson, R. (Tekniska Hoegskolan, Lund (Sweden)); Brune, D.; Lorenzen, J. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Nucl. Instrum. Methods; 123: No. 2, 385-393(15 Jan 1975).

A study of the detection limits for the elements with Z = 15-92 in thick target steel surfaces using proton-induced x-ray technique was performed. Samples were irradiated with a broad proton beam of 2 mm diameter and the x rays were detected by a Si(Li) detector. Detection limits at levels down to the order of 10 ppM were achieved with simultaneous measurement of several elements. Mylar and chromium absorbers were introduced in front of the semiconductor detector and irradiations at two different proton energies (1.0 and 2.5 MeV) were carried out in order to elucidate their effects on detection limits. The results are valid for microbeam analysis. (auth)

32522 X-RAY FLUORESCENT DETERMINATION OF LANTHANUM, CERIUM, PRASEODYMIUM, AND NEODYMIUM IN PLAIN CARBON AND LOW ALLOY STEELS. Narita, K.; Matsumura, T.; Morooka, R.; Kotani, N.; Goto, T. (Kobe Steel Ltd. (Japan). Central Research and Development Lab.). Trans. Iron Steel Inst. Jap.; 14: No. 3, 202-207(May 1974).

An investigation was undertaken to determine four rare earth elements (La, Ce, Nd, and Pr) in the range of 0.005 to 0.15% by x-ray fluorescent spectrometry. In the absence of reliable standards, the glass bead technique for irregularly shaped samples such as drillings was developed. Rare earth elements were precipitated as the fluorides after dissolving 5 g of the sample in sulfuric acid, the filtered fluorides were then ignited to oxides, mixed with sodium tetraborate, and melted to prepare the glass beads. The glass bead method ensured a precision of less than 2% of the amount present. A good agreement was obtained between the chemical and x-ray results. The advantages of the method were the facility of the construction of an analytical curve by using chemical reagents, the absence of interelemental effects because of the separation of rare earth elements, and the versatility to be applicable to other materials with minor modifications. The standard samples of low alloy steels for the direct metal disk technique were furthermore prepared and a conventional procedure was taken with satisfactory results. (auth)

32523 SEPARATION AND DETERMINATION OF RADIO-RUTHENIUM. Watari, K. (National Inst. of Radiological Sciences, Chiba (Japan)); Iwashima, K. Kagaku No Ryoiki; 28: No 4, 298-306(Apr 1974). (In Japanese).

The analysis of radioactive ruthenium in seawater is reviewed, with emphasis on sampling, as it is important in radioactive waste disposal and the geochemical cycle of the fallout. Coprecipitation and adsorption methods are mentioned. Effective sampling suitable for the treatment of large quantities and high concen-

trations of salt such as seawater is also mentioned. The International Laboratory of Marine Radioactivity (Monaco) summarized the results of international comparison analysis of ruthenium that shows complicated co-precipitation and adsorption behavior. The international procedure of comparison, analytical results, and their dispersion are partly introduced. Sulfide co-precipitation methods, particularly the cobalt sulfide coprecipitation method, may be recommended for such low radioactive substances as ^{106}Ru in seawater. Effective enrichment of ^{106}Ru is required, because direct γ-spectrometry broadens the distribution of analytical values, and the γ-spectrometry needs carefulness in the spectrum analysis because of the difficulty due to other coexisting nuclei. In case of the chemical separation procedure and measurement with beta particles of the basic oxidation of samples and the solvent extraction of ruthenium tetraoxide give good results. The analytical method for ^{106}Ru in environmental samples is believed to be nearly established. (JA)

32524 DETERMINATION OF MICROQUANTITY OF ETHYLPHENYLEPHRINE IN PLASMA BY RADIOISOTOPE DERIVATIVE METHOD USING P-TOLUENESULFONYL[^{35}S] CHLORIDE. Hiraoka, T. (Sankyo Co. Ltd., Tokyo (Japan)). Chem. Pharm. Bull. (Tokyo); 22: No. 11, 2511-2517(Nov 1974).

A determination of microquantity of ethylphenylephrine in plasma of dogs and human volunteers after oral administration of a therapeutic dose was investigated by the radioisotope derivative method using p-toluenesulfonyl[^{35}S] chloride (tosyl[^{35}S] chloride). Tosyl chloride, in a weak alkaline medium containing 33% acetone, reacted with the phenolic hydroxyl and amino group of ethylphenylephrine molecule, producing N-tosyl-ethylphenylephrine tosylate, and reacted with the phenolic hydroxyl group of the drug in a neutral medium, producing ethylphenylephrine tosylate. A linear correlation was found between the amount of ethylphenylephrine (0.0125-0.1 μg) added to human plasma and the radioactivity of N-tosyle-thylphenylephrine tosylate-^{35}S derivative produced from ethylphenylephrine which was extracted from the plasma samples. After the administration of ethylphenylephrine in dogs, about 56 to 80% of total plasma level was found as unchanged drug in plasma. On the contrary, unchanged ethylphenylephrine was not detected in human plasma after oral administration of the drug. After oral administration of the sustained-release capsule, plasma level was compared with that of the uncoated tablet in man and it was found that increase of plasma level was slower and more durable after administration of the sustained-release capsule than that of the uncoated tablet. Thus, the radioisotope derivative method using tosyl[^{35}S] chloride was useful for determination of a microquantity of ethylphenylephrine or its metabolite in plasma. (auth)

32525 USE OF GAMMA SPECTROMETRY FOR INVESTIGATING MAGMATIC ROCKS IN THE TAMDIN AND KURAMIN MOUNTAINS (UZBEKISTAN). Magdiev, R. A. Uzb. Geol. Zh.; No. 2, 68-71(1973). (In Russian).

The content of U (from Ra), Th, and K in magmatic ores was investigated by gamma spectrometry of natural rock outcroppings on the surface of the earth. Results are presented on confirming the reliability of the data which were obtained. The results can be used not only directly but also for improving the accuracy of the geological age (at mutual ratios of the ores), and tracing out fractures, zones of mineralization, etc. during surveys of large areas. (tr-auth)

Separation Procedures

32526 (CEA-CONF-2907) PRESENT STUDY AND DEVELOPMENT OF EXTRACTION PULSED COLUMNS. Rouyer, H.; Lebouhellec, J.; Henry, E.; Michel, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). [nd]. 31p. (CONF-740917-11). Dep. NTIS (US Sales Only) $4.75.

From international solvent extraction conference; Lyon, France (8 Sep 1974).

Pulsed column hydraulics and efficiency variation in pulsed columns were studied. A comparative cost equipment estimate for an industrial installation is given. (LK)

32527 (JAERI-M-5567, pp 333-337) MUTUAL SEPARATION OF AQUEOUS HEAVY IONS BY PAPER ELECTROPHORESIS. Ikeda, N.; Kimura, K.; Ichikawa, G. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Rapid mutual separations of three heavy ion groups (Th-Pa-U; U-Np-Pu; Am-Cm) were achieved by means of paper electrophoresis. The paper used was 2.5 cm × 25 cm Cellogel strip, the buffer solution 0.5 to 0.8 M α-hydroxy iso-butylic acid solution with pH 2.0 to 3.0, and the applied voltage 2000 V. It took only 25 to 30 min for complete separation of the elements of each group. (auth)

32528 (JAERI-M-5567, pp 338-341) SEPARATION CHEMISTRY OF VARIOUS ELEMENTS PRODUCED BY HEAVY-ION IRRADIATION. Umezawa, H. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

The necessity for systematic separation is discussed and a feasible ion-exchange scheme is designed to separate various elements. Special techniques for preparation of highly pure water and some chemical reagents are also presented. (auth)

32529 (WANL-TMI-1952) CHEMICAL ASPECTS AND APPROACHES TO MINING THE OCEANS FOR URANIUM. Roesmer, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1968. 18p. Dep. NTIS $4.00.

A thorough survey on coprecipitation systems which have been used to collect and concentrate uranium traces in seawater is presented. A specific collection system, ferric hydroxide $Fe(OH)_3$ is recommended as suitable for scaling up into a production process. The ferric hydroxide coprecipitation system also removes many precious metals dissolved in seawater. Their recovery may improve considerably the economics of mining the oceans for uranium. (auth)

32530 PROPERTIES OF SOLID AND LIQUID ION EXCHANGERS. I. Selectivity Studies on Dinonylnaphtalene Sulfonic Acid Dissolved in Heptane: Comparison Between Liquid and Solid Cation Exchangers. Soldatov, V.; Hogfeldt, E. (Royal Inst. of Tech., Stockholm). Ion Exch. Membranes; 2: No. 1, 13-20(Sep 1974).

Ion exchange equilibria at 25°C in the systems Li^+-H^+, Na^+-H^+, K^+-H^+, Rb^+-H^+ and Cs^+-H^+, $Mg^{2+}-H^+$; $Ca^{2+}-H^+$, $Sr^{2+}-H^+$ and $Ba^{2+}-H^+$, have been studied with the liquid cation exchanger dinonylnaphtalene sulfonic acid (HDNNS) dissolved in heptane. The water uptake of the various salts as well as their mixtures has been studied at unit water activity. The exchanges K^+-H^+ and $Ca^{2+}-H^+$ on HDNNS sorbed on Amberlite XAD-2 has also been studied. The great similarities found between the extraction isotherms for HDNNS-salts and solid resins seem to rule out the suggestion that heterogeneity effects are responsible for the variation in selectivity with composition. For that reason a simple alternative explanation valid for both solid and liquid exchangers is suggested. (auth)

32531 STUDIES IN ION EXCHANGE EQUILIBRIA. II. Some Cation and Anion Exchange Selectivities in Amberlite Resins. Pal, G. C.; Chakravarti, A. K.; Sengupta, M. (University Coll. of Science, Calcutta). Ion Exch. Membranes; 2: No. 1, 21-27(Sep 1974).

Ion exchange equilibria have been studied by the batch technique in synthetic organic cation and anion exchangers (Amberlite IR 120 and Amberlite IRA 400 respectively). The following exchange equilibria have been studied, starting in almost all cases from either of the pure ionic forms of the resin involved: (i) $Ba^{++}-Mg^{++}$, (ii) $Ba^{++}-La^{+++}$, (iii) $Ba^{++}-Th^{++++}$, (iv) $La^{+++}-Th^{++++}$, (v) H^+-Ba^{++}, (vi) $H_2PO_4^--Cl^-$, (vii) $H_2PO_4^--SO_4^{--}$ and (viii) $Cr_2O_7^{--}-Cl^-$. The ideal solid solution model of Argersinger et al. has been considered in the calculation of the thermodynamic equilibrium constants; the specific ionic interactions in the solution phase in so far as these affect the corresponding ionic activities, have been taken into account in this calculation. (auth)

32532 PARTLY NON-AQUEOUS MEDIA FOR ACCURATE CHEMICAL ANALYSIS BY ION EXCHANGE. Strelow, F. W. (National Chemical Research Labs., Pretoria). Ion Exch. Membranes; 2: No. 1, 37-46(Sep 1974).

Cation exchange separation of elements of Group IIIA and some other cations has been completed in mixed solvent media. Cu(II) and U(VI) were separated selectively. Selectivity series and coefficients have been studied and extreme accuracy achieved. As an example of utilizing the HCl-HBr elution techniques in aqueous acetone solution a mixture of typical rock-constituents was separated. 10 to 70 mg Na, K, Ca, Mg, Mn, Fe, Al, Ti, plus trace amounts of V and Zr were used in the solution. (auth)

32533 SEPARATION OF SAMARIUM FROM LANTHANUM, PRASEODYMIUM, AND NEODYMIUM BY THE AMALGAM METHOD. Tikhanina, S. P.; Mamaev, V. E.; Sayun, M. G. (All-Union Scientific Research Mining Metallurgy Inst. of Non-Ferrous Metals, Moscow). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 18: No. 3, 377-380(1975). (In Russian).

A method was proposed for the separation of Sm from the rare earth metals of the Ce subgroup by the anode reduction of their mixed amalgams in sulfuric acid solution with control of the poten-

tial. It was shown that during the decomposition by mixing the mixed Sm–La, Ce, Pr, Nd amalgams, containing 1 g of Sm_2O_3 and 20 g of La_2O_3, Ce_2O_3, Pr_2O_3, and Nd_2O_3 in 1 l of Hg, in a 1N solution of H_2SO_4 with control of the potential, after one operation a 65 to 87% Sm product was obtained. (tr-auth)

32534 EXTRACTION OF EUROPIUM BY BIS(2-ETHYLHEXYL)PHOSPHORIC ACID CONTAINING ZIRCONIUM. Sinegribova, O. A.; Yagodin, G. A.; Kotsar, N. S.; Semenov, G. I.; Pukhonto, L. I. (Moscow Chemical-Technical Inst.). Zh. Neorg. Khim.; 20: No. 1, 189-193(Jan 1975). (In Russian).

The extraction of Eu by di-2-ethylhexylphosphoric acid sharply increases if Zr is first added to the organic phase to be extracted. Eu is extracted by an ion-exchange mechanism displacing the hydrogen ions from the compound $ZrA_2(HA)_2$. In the presence, in the organic phase, of ZrA_4 compounds not containing hydrogen ions, the extraction of Eu proceeds by a solvate mechanism. (tr-auth)

32535 MECHANISM FOR THE EXTRACTION OF NIOBIUM AND TANTALUM FROM FLUORIDE SOLUTIONS BY OXYGEN-CONTAINING EXTRACTANTS. Nikolaev, A. I.; Il'in, E. G.; Spivakov, B. Ya.; Shcherbakova, M. N.; Babkin, A. G.; Buslaev, Yu. A.; Zolotov, Yu. A. Zh. Neorg. Khim.; 20: No. 1, 194-198 (Jan 1975). (In Russian).

The mechanism for the extraction of fluoride complexes of Nb and Ta was studied by NMR measurements on ^{19}F and ^{93}Nb, IR spectroscopy, and chemical analysis. NMR data and the chemical analysis of the extracts showed that singly charged complexes with the composition NbF_6^- and TaF_6^- were extracted from fluoride and fluoride–sulfate solutions of petroleum sulfoxides, cyclohexanone, methyl isobutyl ketone, and tributyl phosphate. The IR spectral data showed that oxygen-containing extractants extract Nb and Ta by a hydrate-solvate mechanism; oxyfluorides of Nb and Ta were not detected in the extracts. The causes for the different behavior of Nb and Ta during re-extraction were discussed. (tr-auth)

32536 KHIMICHESKAYA TEKHNOLOGIYA PERERABOTKI REDKOMETAL'NOGO SYR'YA KOL'SKOGO POLUOSTROVA. (Chemical Technology for Processing Rare Metal Raw Materials of the Kola Peninsula). Babkin, A. G. (ed.). Leningrad; Izdatel'stvo Nauka 1972 . 124p.

A compilation is presented of 18 papers on the study and development of procedures to be used for the processing of raw materials from the Kola Peninsula. Separate abstracts were prepared for eight of the papers. (JSR)

For abstracts of individual papers see: 32537–32544.

32537 SEPARATION OF THORIUM AND THE RARE-EARTH ELEMENTS BY EXTRACTION WITH CYCLOHEXANONE. Konyukhova, L. I.; Belokoskov, V. I.; Panasenko, E. B. pp 11-17 of Khimicheskaya Tekhnologiya Pererabotki Redkometal'nogo Syr'ya Kol'skogo Poluostrova. Babkin, A. G. (ed.). Leningrad; Izdatel'stvo Nauka (1972). (In Russian)

The results of the study of the separation of Th and the rare earths by extraction with cyclohexanone were reported. The effects of the concentration of ThO_2, HNO_3, and NH_4NO_3 and of the phase ratio were studied. The optimum conditions for the single-step extraction of 75% of the Th in the organic phase were determined. During countercurrent extraction in eight stages 95.9% of the ThO_2 was removed in the organic phase. (tr-auth)

32538 EXTRACTION OF TITANIUM AND THORIUM BY FOAMS OF ALIPHATIC ACID IN THE PRESENCE OF RARE EARTH ELEMENTS. Belokoskov, V. I.; Goryainov, I. M.; Myamlina, E. N. pp 17-22 of Khimicheskaya Tekhnologiya Pererabotki Redkometal'nogo Syr'ya Kol'skogo Poluostrova. Babkin, A. G. (ed.). Leningrad; Izdatel'stvo Nauka (1972). (In Russian)

The aliphatic acid extraction of Ti and Th from pure solutions and from solutions containing Ti, Th, and rare earth elements was studied. The possibility of the extraction separation of Ti and Th from the rare earth elements at different pH values was shown. (tr-auth)

32539 EXTRACTION OF RARE EARTH ELEMENTS USING THE BOCK–WILSON METHOD. Panasenko, E. B.; Begunova, R. G.; Maiorov, V. G. pp 22-28 of Khimicheskaya Tekhnologiya Pererabotki Redkometal'nogo Syr'ya Kol'skogo Poluostrova. Babkin, A. G. (ed.). Leningrad; Izdatel'stvo Nauka (1972). (In Russian)

The results of the study of the separation of the rare earth elements in group concentrates during TBP extraction from nitrate solutions in the presence of salting-out agents (calcium nitrate and ammonia) were reported. By means of the Bock-Wilson method, the optimum conditions for the process were determined. Under these conditions 70% of the Sm, Eu, and Gd and 20% of the La, Ce, Pr, and Nd were extracted in a single step into the organic phase. In a 10-stage cascade process Sm, Eu, and Gd were completely extracted in the contents of these elements in all the oxides is 3.6%. The extraction of the other rare earth elements in the raffinate is more than 80%. (tr-auth)

32540 DISTRIBUTION OF MOLYBDENUM(6+), TUNGSTEN (6+), AND IRON(3+) DURING CYCLOHEXANONE EXTRACTION FROM FLUORIDE–SULFATE SOLUTIONS. Maiorov, V. G.; Balabanov, Yu. I.; Babkin, A. G.; Bogdanov, M. N.; Kopkov, V. K. pp 28-36 of Khimicheskaya Tekhnologiya Pererabotki Redkometal'nogo Syr'ya Kol'skogo Poluostrova. Babkin, A. G. (ed.). Leningrad; Izdatel'stvo Nauka (1972). (In Russian)

The distribution of Mo(6+), W(6+), and Fe(3+) during cyclohexanone extraction from fluoride-sulfate solutions was studied by use of radioactive isotopes and factor planning of the experiment. It was shown that the distribution of W and Fe is practically independent of the concentration of impurities in the limits from 0.001 to 1 g/l. The degree of extraction of Mo increases with decrease of its concentration. The occurrence of co-extraction of Mo and W with the microcomponent Ta was established. (tr-auth)

32541 EFFECT OF RESINIFICATION PRODUCTS OF CYCLOHEXANONE ON THE EXTRACTION OF TANTALUM AND NIOBIUM. Maiorov, V. G.; Balabanov, Yu. I.; Babkin, A. G.; Kopkov, V. K.; Nikolaev, A. I. pp 36-44 of Khimicheskaya Tekhnologiya Pererabotki Redkometal'nogo Syr'ya Kol'skogo Poluostrova. Babkin, A. G. (ed.). Leningrad; Izdatel'stvo Nauka (1972). (In Russian)

It was shown that during the contact of cyclohexanone with acid solutions a deterioration of its extraction capacity occurs as a result of the accumulation in the organic solution of cyclohexylidenecyclohexanone, a resinification product of cyclohexanone. The extraction of Ta and Nb was studied at different ratios of the cyclohexanone : resin in the organic solution and for variable ratios of the volumes of the organic : water phases during extraction. (tr-auth)

32542 ELECTRODIALYSIS FOR THE SEPARATION OF ZIRCONIUM AND FLUORINE. Godneva, M. M.; Motov, D. L. pp 49-55 of Khimicheskaya Tekhnologiya Pererabotki Redkometal'nogo Syr'ya Kol'skogo Poluostrova. Babkin, A. G. (ed.). Leningrad; Izdatel'stvo Nauka (1972). (In Russian)

Low-voltage electrodialysis with ion exchange membranes (I) and high-voltage electrodialysis with inert membranes (II) were studied for possible use in the separation of Zr and F. Solutions of zirconium hydroxyfluoride in 1 to 4N H_2SO_4 were used for I and suspensions of the hydroxyfluoride in water were used for II. In I some separation occurred as a result of the large degree of transfer of F into concentrating solution. However complete destruction of the very stable complex of Zr and F was not achieved. The adsorption of Zr and F on EDE-10P resin did not cause its decomposition. In II with increase of the voltage, separation of the F from the suspension was attained. (tr-auth)

32543 SULFOXIDES AS EXTRACTANTS FOR TANTALUM AND NIOBIUM. Babkin, A. G.; Nikolaev, A. I.; Chistyakov, B. E. pp 104-111 of Khimicheskaya Tekhnologiya Pererabotki Redkometal'nogo Syr'ya Kol'skogo Poluostrova. Babkin, A. G. (ed.). Leningrad; Izdatel'stvo Nauka (1972). (In Russian)

The effect of the composition of the aqueous and organic solutions on the separation of Ta and Nb when using sulfoxides of a petroleum origin as extracting reagents was studied. The joint effect of the concentration of the metals, HF, and H_2SO_4 and the ratio of the volumes of the organic and aqueous phases, as well as studies to make more precise the conditions for the extraction of Ta and Nb, were carried out by using factor planning of the experiment. It was established that sulfoxides of a petroleum origin are effective extracting agents for the separation of Ta and Nb from fluoride-sulfate media. Under the optimum conditions the separation of Ta is 95.0% and that of Nb is 83.5 to 91.0%. (tr-auth)

32544 SEPARATION OF TANTALUM AND NIOBIUM BY SULFOXIDE EXTRACTION FROM FLUORIDE–SULFATE SOLUTIONS. Nikolaev, A. I.; Babkin, A. G.; Maiorov, V. G. pp 111-117 of Khimicheskaya Tekhnologiya Pererabotki Redkometal'nogo Syr'ya Kol'skogo Poluostrova. Babkin, A. G. (ed.). Leningrad; Izdatel'stvo Nauka (1972). (In Russian)

By use of factor planning of experiments, the effects of the concentration of HF and H_2SO_4 and the volume ratio of the organic and aqueous phase on the separation of Ta and Nb from solutions with the ratio $Ta_2O_5 : Nb_2O_5 = 1$ and 2 by sulfoxides of petroleum origin were examined. Under the best conditions found for the separation of the metals the value of the optimization parameter (sum of the separation of Ta in the organic phase and of Nb in the aqueous phase) reaches 196 to 197%. The high value of the indicators for the separation of Ta and Nb made it possible to

consider sulfoxides as an effective extractant for the separation of these metals. (tr-auth)

32545 STUDY OF THE PROCESS OF COMPLEX FORMATION OF THE RARE EARTH ELEMENTS WITH IMINODIACETIC ACID BY THE METHOD OF ION EXCHANGE. Martynenko, L. I.; Kupriyanova, G. N.; Spitsyn, V. I. (Moscow State Univ.). Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 23: No. 7, 1399-1401(Jul 1974).

Translated from Izv. Akad. Nauk SSSR, Sen. Khim.; 23: No. 7, 1476-1478(Jul 1974).

The coefficients of separation (α) were determined for the system cation exchange resin-Ln-iminodiacetic acid. The dependence of the values of α on the iminodiacetic acid concentration and pH was investigated. A comparison of the values of α_{exp} and $\alpha_{theoret}$ permits a determination of the composition of the complexes participating in the ion exchange process. The degree of separation of mixtures of cerium REE with triiminodiacetates ($\alpha_{exp} = 2.60$) is higher than in systems with mono- and diiminodiacetates ($\alpha_{exp} = 1.15, 1.48$). (auth)

32546 SPECTROPHOTOMETRIC STUDY OF THE SOLVENT EXTRACTION OF BERYLLIUM(II)-CHROMAZUROL S-HEXADECYLTRIMETHYLAMMONIUM TERNARY COMPLEX. Ishida, R.; Tonosaki, K. (Hirosaki Univ., Aomori (Japan). Faculty of Science). Nippon Kagaku Kaishi; 1974: No. 6, 1077-1082(Jun 1974). (In Japanese).

Chromazurol S (ChS) reacted with beryllium(II) in the presence of hexadecyltrimethylammonium (HDTMA) salt to form a ternary complex of blue coloration. The ternary complex was completely extractable into 1-butanol in the pH range from 6.6 to 7.0, and it had an absorption maximum at 596 nm. The absorbance of 1-butanol extract remained constant for many hours at room temperature. Under the optimum conditions of pH, reagent concentrations and the others, the absorbance of the extracted complex obeyed Beer's law over the concentration range up to 7 μmole/ℓ beryllium(II) in aqueous phase, and the optimum concentration range of beryllium(II) determination was between 0.95 and 3.3 μmole/ℓ (Ringbom's plot). The molar absorptivity at 596 nm was $58500\ell \cdot cm^{-1} \cdot mole^{-1}$ corresponding to Sandell's sensitivity index of 0.00015 $\mu g/cm^2$. The molar ratio of three components in the extracted species was estimated to be Be(II): ChS: HDTMA = 1 : 2 : 4. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstract 32619.

Chemical and Physicochemical Properties

Refer also to abstracts 32635, 33096, 33538, 33765, and 33808.

32547 (CEA-N-1743) CONTRIBUTION TO THE STUDY OF POLYMERS IN SOLUTION BY SMALL-ANGLE NEUTRON SCATTERING. Cotton, J.-P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services de Physique Generale; Paris-6 Univ., 75 (France)). Aug 1974. 86p. (In French). INIS.

The use of small angle neutron scattering for studying polymer chain mixtures is discussed. The solute-solvent contrast factor is determined from the incompressibility hypothesis and leads to an expression of the scattering law of polymer solutions applicable to all concentration ranges. An apparatus is described that may utilize the neutron flux of a research reactor. The results of neutron scattering by polystyrene chain solutions at intermediate concentrations are discussed; they are in good agreement with the theory of semi-dilute solutions given by Edwards. (FR)

32548 (INS-TCH-8) THE TARGET CHEMISTRY OF PALLADIUM. Komura, K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 24 Jun 1974. 23p. (In Japanese). INIS.

A method is described for the preparation of self-supporting palladium foil. Palladium was electrodeposited on the 10 μm thick copper foil from the solution of $[Pd(NH_3)_4] \cdot (NO_3)_2$. A uniform and solid self-supporting palladium foil of 1.5 ~ 3 mg/cm^2 thick was prepared by this method and used in the experiment of Pd(p,p') reaction. The preparation of electrolytic solution, the conditioning of cathode foil and the practice of electrodeposition are described in detail. A method is also described for the preparation of carrier-free ^{109}Pd from the proton-bombarded rhodium target. The rhodium target was made by compressing the $RhCl_3 \cdot 3H_2O$ crystal with 1 ton hand press. After the bombardment, the target was dissolved in diluted HCl and radioactive palladium was chemically separated from rhodium by coprecipitating with Ni-Dimethylglyoxime. Purification by an anion exchange method was applied to remove the spurious amount of rhodium and nickel. About 1 mCi of carrier-free ^{109}Pd was obtained by the method and used for the measurement of conversion electrons from the decay of ^{109}Rh. (auth)

32549 (JAERI-M-5567, pp 74-80) REACTION OF METHANOL WITH ACCELERATED RARE GAS IONS. Arai, E.; Takahashi, M. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

In order to study the chemical reaction of accelerated ions, an apparatus for ion impact was constructed. Rare gas ions (Ar, Xe and Kr) are generated by electrical discharge of 70 MHz radio wave, extracted and accelerated up to 2 to 6 kV, and injected into a reaction chamber of glass tube. Methanol is used as target in the present experiment. The products, H_2, CO, and CH_4 are collected and analyzed by gas-liquid chromatography. The yields of the products per ion (Y_j) are proportional to the logarithm of the initial energy of ion (E_i) as expressed by the following equation: $Y_j = (p_j/\alpha)\ln(E_i/E_f)$, where p_j is the probability for the j-th process and α is average logarithmic energy loss per collision. It is proposed that the "billiard model" is applicable to the ion impact as well as hot atom chemistry. (auth)

32550 WATER AND ITS SOLUTIONS AT HIGH TEMPERATURES AND PRESSURES. Marshall, W. L. (Oak Ridge National Lab., TN). Chemistry; 48: 6-12(Feb 1975).

The nature of water at high temperatures and at high temperatures combined with high pressure is described. The electrical conductance of salts and acids and the solubility of salts in water at high temperatures and pressures are discussed. Theoretical interpretations of these phenomena are outlined. The applications of these data in geochemistry, oceanography, and water purification and geothermal power production are indicated. (JSR)

32551 SOLUBILITY OF HI_3O_8 IN CONCENTRATED NITRIC ACID. Rainey, R. H.; Mailen, J. C. (Oak Ridge National Lab., TN). J. Chem. Eng. Data; 19: No. 3, 262-263(Jul 1974).

The solubility of HI_3O_8 was determined in 12-20M HNO_3 over the temperature range 25-100°C. The results can be expressed by the following least-squares-developed equation: $\ln S$ (g HI_3O_8/l.) = 13.28 - 0.4515 C(HNO_3) (M) - 1170/T (K). The solid phase at equilibrium was identified as pure HI_3O_8 by X-ray diffraction. (auth)

32552 COMPLEX OXIDES CONTAINING DIVALENT EUROPIUM. I. Guidelines for the Prediction of New Phases. Application to Phases of the Type $EuMO_3$. McCarthy, G. J. (Pennsylvania State Univ., University Park); Greedan, J. E. Inorg. Chem.; 14: No. 4, 772-775(Apr 1975).

The problem of the stability of complex europium(II) oxides is considered in detail. A set of guidelines suitable for both the understanding of existing complex europium(II) oxide phases and the prediction of new phases is developed. These guidelines are applied to compounds of the type $EuMO_3$, most of which have some form of the perovskite structure. $EuNbO_3$ and $EuUO_3$ are reported for the first time. (auth)

Isotope Effects

Refer also to abstracts 32600, 32620, 33618, and 33794.

32553 (AD-785359) VIBRATIONAL SPECTRA AND STRUCTURES OF ORGANIC ACIDS AND THEIR DERIVATIVES. Volume II. Benzoyl Chloride, Benzoyl Bromide, and Methyl Chloroformate. Interim Technical Report, 1 January 1972-1 January 1974. Katon, J. E.; Condit, D. A.; Griffin, M. G. (Miami Univ., Oxford, Ohio (USA)). May 1974. 48p. (AFML-TR-74-19-VOL-2). NTIS $3.25.

The infrared and Raman spectra of benzoyl chloride, benzoyl chloride-d_5 and benzoyl bromide have been measured between 75-4000 cm. Assignments for the fundamental modes of vibration are presented. In addition, the infrared spectra of methyl chloroformate and methyl chloroformate-d_3 are reported. It is found that the two compounds readily crystallize as oriented polycrystalline films when cooled in contact with cesium iodide windows. The polarized infrared spectra obtained with these films makes possible an improved vibrational assignment for the light compound and a good first assignment for the deuterium substituted analogue. The results are most consistent with a planar cis structure and there is no indication of the existence of a second conformer. No clear cases of crystal splitting are observed. (auth)

32554 ISOTOPE EFFECT IN DIFFUSION: EFFECT OF RESONANCE MODES. Narahari Achar, B. N. (Argonne National Lab., Ill. (USA)). Indian J. Technol.; 11: No. 10, 456-459(Oct 1973).

From international symposium on defect interactions in solids; Bangalore, India (9 May 1972). 11 refs., 4 figures, work performed under the auspices of US Atomic Energy Commission.

The lattice dynamics theory of diffusion treats atomic jumps as due to displacements in excess of a critical value, resulting from a superposition of the normal modes of vibration of the crystal. Isotopic impurities introduce resonance and local modes. The results of a study on the effect of resonance modes on the isotope effect, ΔK, in simple metals are presented. Numerical results indicate a drastic reduction in the value of ΔK as the ratio of impurity to host mass increases. Possible experimental verification is discussed. (auth)

32555 KINETIC ISOTOPE EFFECTS FOR THE CHYMOTRYSPIN CATALYZED HYDROLYSIS OF ETHOXYL-^{18}O LABELLED SPECIFIC ESTER SUBSTRATES. Sawyer, C. B.; Kirsch, J. F. (Univ. of California, Berkeley). J. Amer. Chem. Soc.; 97: No. 7, 1963-1964(2 Apr 1975).

Results of ^{18}O kinetic isotope effect measurements for the chymotrypsin-catalyzed hydrolysis of N-acetyl-L-tryptophan ethyl ester-ethoxyl-^{18}O (I) and N-carbomethoxy-L-tryptophan ethyl ester-ethoxyl-^{18}O (II) are reported. The 1.2 and 1.8% ^{18}O kinetic isotope effects observed for the hydrolyses of esters I and II are close to that observed for the general base catalyzed hydrolysis of methyl formate. This observation supports the proposed general base catalysis mechanism for the acylation of chymotrypsin. (LK)

32556 SEARCH FOR ISOTOPE EFFECTS IN THE SELF-DIFFUSION OF BENZENE AND CYCLOHEXANE AT 25°. Mills, R. (Australian National Univ., Canberra). J. Phys. Chem.; 79: No. 8, 852-853(10 Apr 1975).

A search has been made for possible isotope effects in the self-diffusion of benzene, cyclohexane, and their deuterated analogs at 25°. The diaphragm cell method was used throughout. No isotopic effect could be detected within average error limits of ±0.3%. This finding is in agreement with the theoretical predictions of Friedman. (auth)

32557 BINARY COPPER CARBONYLS. Synthesis and Characterization of $Cu(CO)_3$, $Cu(CO)_2$, CuCO, and $Cu_2(CO)_6$. Huber, H.; Kuending, E. P.; Moskovits, M.; Ozin, G. A. (Univ. of Toronto). J. Amer. Chem. Soc.; 97: No. 8, 2097-2106(16 Apr 1975).

The products of the cocondensation reaction of copper atoms with carbon monoxide at 10-15°K are investigated by matrix infrared and uv-visible spectroscopy and are shown to be binary copper carbonyls. Examination of the reaction products in $^{12}C^{16}O$, $^{12}C^{16}O-^{13}C^{16}O$, $^{12}C^{16}O-Ar$, $^{12}C^{16}O-^{13}C^{16}O-Ar$, and $^{12}C^{16}O-^{13}C^{16}O-^{12}C^{18}O-Ar$ together with matrix warm-up experiments, carbon monoxide and copper concentration dependence studies, as well as experiments involving the simultaneous codeposition of Cu and Ag atoms with CO, establishes the stoichiometries of the complexes to be $Cu(CO)_3$, $Cu(CO)_2$, Cu(CO), and $Cu_2(CO)_6$. Dicopper hexacarbonyl could be synthesized by the matrix dimerization of $Cu(CO)_3$ at 45-50°K or by the reaction of Cu_2 molecules and/or $Cu_2(CO)_n$ complexes with pure CO at 10-15°K. Isotopic frequencies are computed for the CO stretching modes of triangular planar $Cu(CO)_3$ and linear $Cu(CO)_2$ on the basis of the Cotton-Kraihanzel force field approximation and are found to be in close agreement with the observed values. Triple isotope experiments using $^{12}C^{16}O-^{13}C^{16}O-^{12}C^{18}O-Ar$ mixtures are used to characterize CuCO. The data are also used to test the feasibility of probing the mode of bonding of the CO group to the copper. The infrared data for $Cu_2(CO)_6$ are consistent with a structure containing a Cu-Cu bond. Qualitative molecular orbital schemes, consistent with the uv-visible spectroscopic data, are presented for $Cu(CO)_3$ and $Cu_2(CO)_6$. It is proposed that an extremely intense absorption of 417 nm, observed in the electronic spectrum of $Cu_2(CO)_6$, is associated with the $\sigma-\sigma^*$ transition between orbitals of the copper-copper bond and as such can be taken as an approximate measure of the strength of the copper-copper bond. Preliminary matrix uv-visible, copper-argon concentration experiments are briefly described and, besides showing copper atoms, yield evidence for the formation of diatomic copper molecules. (auth)

32558 SUBSTITUENT AND SECONDARY α-DEUTERIUM ISOTOPE EFFECTS ON RATES OF ELIMINATION OF HBr FROM 1-ARYL-1-BROMOPROPANES WITH TETRA-N-BUTYLAMMONIUM BROMIDE IN ACETONE. Ford, W. T.; Pietsek, D. J. J. (Univ. of Illinois, Urbana). J. Amer. Chem. Soc.; 97: No. 8, 2194-2198(16 Apr 1975).

Rate constants for tetra-n-butylammonium bromide catalyzed elimination of HBr from seven 1-aryl-1-bromopropanes have been determined in acetone at 74.63°. A Hammett plot of the rate data vs. σ^+ is curved. Electron-providing substituents cause slightly faster reaction, but the rate difference between p-CH_3 and m-NO_2 compounds is only a factor of 4. Rate constants of the competing uncatalyzed E1 eliminations were determined with four 1-aryl-1-bromopropanes. A Hammett plot of the uncatalyzed rates vs. σ^+ gives $\rho = -4.76$. The E1 reaction of 1-bromo-1-(4-methoxyphenyl)propane is so fast that 0.094 M Bu_4N Br fails to promote the elimination rate. Secondary α-deuterium isotope effects on the Bu_4N Br-catalyzed reactions of 1-bromo-1-phenylpropane and 1-bromo-1-(4-tolyl)propane are $k_H/k_D = 1.128$ and 1.146, respectively. The substituent effects rule out a carbonium ion intermediate for the Bu_4NBr-catalyzed eliminations. The isotope effects point to nearly sp^2-hybridized carbon and rule out extensive bonding between base and C_α in the elimination transition state. A concerted E2 mechanism in which the double bond is substantially formed in the transition state is most compatible with the results. (auth)

32559 ETHYL TRICHLOROACETATE HYDROLYSIS. I. Kinetic Evidence for a Common Tetrahedral Intermediate in the Acid-Catalyzed and Water-Catalyzed Hydrolyses. Kurz, J. L.; Farrar, J. M. (Washington Univ., St. Louis). J. Amer. Chem. Soc.; 97: No. 8, 2250-2254(16 Apr 1975).

The rates of hydrolysis of ethyl trichloroacetate and ethyl trifluoroacetate increase nonlinearly with increasing hydronium ion concentration at constant ionic strength. For ethyl trichloroacetate, this rate increase is shown to be a consequence of unsymmetrically catalyzed partition of the intermediate which is formed from the water-catalyzed addition of water to the carbonyl group of the ester. The value of the partitioning ratio in the limit of zero hydronium ion concentration is calculated from the kinetic data and found to be identical with the value derived from measurements of the oxygen-18 exchange which accompanies the water-catalyzed hydrolysis. It is further shown that for esters which are sufficiently weakly basic, if acid catalysis of hydrolysis is observed, then this unsymmetric partition is expected to be the mechanism for the catalysis instead of the $A_{Ac}2$ mechanism commonly observed for unsubstituted carboxylic esters. (auth)

32560 ETHYL TRICHLOROACETATE HYDROLYSIS. III. Solvent Isotope Effects and Thermodynamic Activation Parameters for the Water-Catalyzed Hydrolysis. Kurz, J. L.; Ehrhardt, G. J. (Washington Univ., St. Louis). J. Amer. Chem. Soc.; 96: No. 8, 2259-2263(16 Apr 1975).

Values of the rate constant, ΔH^{2+}, ΔS^{2+}, and ΔC_p^{2+} are reported for the hydrolysis of Cl_3CCO_2Et in H_2O and D_2O; the value of k_{H_2O}/k_{D_2O} passes through a minimum near 44°. These values are combined with data for the partition of the tetrahedral intermediate to give the following parameters for the first step (addition of water to the carbonyl group) in the hydrolysis mechanism at 25°: $k_{1,H_2O}/k_{1,D_2O} = 2.2$, and for H_2O solutions $\Delta H_1^{\ddagger} = 8.4$ kcal mol^{-1}, $\Delta S_1^{\ddagger} = -44$ cal deg^{-1}, and $\Delta C_{p,1}^{\ddagger} \approx -52$ cal deg^{-1} mol^{-1}. These values are quantitatively explainable on the basis of a transition state for the addition which includes a large extent of charge separation (e.g., one which is near in structure to a hydrogen-bonded dipolar intermediate, $L_2O\ldots L_2O^+-C(CCl_3)(OEt)-O^-$). The presence of additional specifically bound water molecules in the transition state is not required by these explanations. The solvent isotope effect on the partition ratio for the tetrahedral intermediate suggests that the eliminations of water and of ethanol from that intermediate may involve different rate-determining processes. (auth)

32561 THE KINETICS AND MECHANISM OF HYDROGEN ADSORPTION AND HYDROGEN-DEUTERIUM EQUILIBRATION ON THE COPPER SURFACE. Kiyomiya, M.; Momma, N.; Yasumori, I. (Tokyo Inst. of Tech. (Japan). Faculty of Science). Bull. Chem. Soc. Jap.; 47: No. 8, 1852-1857(Aug 1974).

The mechanism of H_2-D_2 equilibration reaction over the copper surface was studied in the 40 to 90°C range of temperature and in the pressure range of 4 to 45 Torr. From studies of hydrogen adsorption and the reaction between gaseous deuterium and preadsorbed hydrogen, the reaction was confirmed to proceed via combination between hydrogen and deuterium atoms on the surface. The rate constants for the adsorption and the desorption were optimized by a computer simulation of the reaction-time course and were found to be in satisfactory agreement with the observed results. A marked isotope effect was found in these rates; its influence on the partial pressure dependence of the reaction was discussed. (auth)

32562 RUTHENIUM COMPLEXES. Miki, E.; Ishimori, T. (Rikkyo Univ., Tokyo (Japan). Faculty of Science). Kagaku No Ryoiki; 28: No. 6, 503-512(Jun 1974). (In Japanese).

For Ru nitrosyl complexes, the infrared absorption spectrum of the ^{15}N substitution compound was examined. Ru has the following chemical characteristics: oxidation states of Ru compounds

range widely from VIII to -II; NO complexes containing Ru are more stable than those containing other elements. Carbonyl and phosphine complexes belong to Ru(0) and Ru(II), and halogenonytrosyl complexes belong to Ru(I). In Ru(III), there are complexes of which coordination atoms were V-b and VII-b groups elements. Ru(IV) includes a small number of halogeno complexes. Many fluoride complexes belong to Ru(V) and many oxyso complexes belong to Ru(VI), (VII), and (VIII). As for nitrosyl complexes, the infrared spectrum of ^{15}N substitution compound in N-O, Ru-N and Ru-N-O were examined with $K_2[RuCl_5(NO)]$. Reactions between RuNO complexes and Sn and between RuNO complexes and N_3^-, N_2H_4 and amine were studied by examining the effects of isotopic shift. It was presumed that NO or N-base is coordinated for Ru and that NO-base react to metal and other bases without separating the bond of Ru-N. (JA)

32563 KINETIC ISOTOPE EFFECT DURING HYDROGEN EXCHANGE OF $C_6H_6Cr(CO)_2P(C_6H_5)_3$ WITH TRIFLUOROACETIC ACID. Zdanovich, V. I.; Yakushin, F. S.; Setkina, V. N.; Baranetskaya, N. K.; Kursanov, D. N.; Shatenshtein, A. I. (Inst. of Heteroorganic Compounds, Moscow). Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 23: No. 7, 1579-1580(Jul 1974).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 23: No. 7, 1655-1656(Jul 1974).

The exchange rates of the deuterium and tritium in the π-bonded benzene ring of benzenechromium dicarbonyl triphenylphosphine with the hydrogen of trifluoroacetic acid were measured, and it was shown that the kinetic isotope effect is absent. (auth)

32564 NEAR INFRARED SPECTROSCOPIC INVESTIGATIONS OF HYDROGEN-BONDING OF WATER IN ORGANIC SOLVENTS AND ALCOHOLS, AND PARTIAL MOLAL VOLUME STUDIES OF SOME SOLUTES IN H_2O AND D_2O. Choi, Y. S. Columbia, SC; Univ. of South Carolina (1974). 171p. University Microfilms Order No. 75-8660.

Thesis (Ph. D.).

The $\nu_2 + \nu_3$ combination band of water has been recorded for bulk water, very dilute solutions of water in various organic solvents, and for nine alcohol-water solutions in which the volume fraction of water is less than two percent. This band of water has also been recorded for tetrahydrofuran-water, acetonitrile-water, dimethylsulfoxide-water, and for three alcohol-water solutions over the entire range of water concentrations. In each instance, absorbance of the weak bands of the organic solvent and alcohol in this region has been eliminated by placing a matched cell or a variable path length cell of pure solvent or alcohol in the reference beam. This also served the purpose of cancelling any trace of moisture in the solvent or alcohol before adding the measured quantity of water. This particular band was chosen because there is no interference from OH groups in hydroxylic solvents such as alcohols, and glycols and hydroxy or amido compounds of biological interest. In addition to these spectroscopic investigations, the partial molal volumes of eleven solutes have been measured in D_2O as a function of concentration and in most instances as a function of temperature. Measurements have also been made in H_2O solutions when they were unavailable in the literature for particular concentrations or temperatures. A pattern emerges for the differences of the partial molal volumes of salts in the two solvents which may be correlated with spectral and other data for the same solutes and which indicates that a relationship exists between these differences and the solvent structure-altering properties of the solutes. (LK)

Isotope Exchange and Isotope Separation

32565 (AD-787669) DIFFUSION OF H AND D IN TiO_2: SUPPRESSION OF INTERNAL FIELDS BY ISOTOPE EXCHANGE. Johnson, O. W.; Paek, S. H.; Deford, J. W. (Utah Univ., Salt Lake City (USA). Dept. of Physics). 1974. 33p. NTIS $3.75.

Measurements of H and D diffusion in TiO_2, using the isotope exchange technique described in the preceding paper, are reported. Use of this technique resulted in diffusion which was accurately described by Fick's law, as predicted theoretically, in sharp contrast to single ion diffusion, where dramatic departures from classical diffusion theory were observed. Ionic conductivity measurements are reported, which agree well with the bulk diffusion measurements, and permit extension of the temperature range of the measurements for c-axis diffusion from 125 to 750°C, corresponding to a range of more than 4 orders of magnitude in D. The measured diffusion parameters were found to be essentially independent of sample purity, although it was observed that significant concentrations of lattice defects sharply inhibited H diffusion. (auth)

32566 ISOTOPIC EXCHANGE AND RACEMISATION OF SOME β-DIKETONATO COMPLEXES. Saito, K. (Tohoku Univ., Sendai (Japan). Faculty of Science). J. Indian Chem. Soc.; 51: No. 1, 47-56(Jan 1974).

With a view to understanding the kinetics of substitution reactions of metal complexes, isotopic exchange and racemization reactions of some β-diketanato complexes, including acetylacetanato complexes of gadolinium and beryllium, in inorganic solvents as influenced by concentrations of solvent, water, acid, ligand and complex have been studied and their lability is compared. It has been found that the sequence: Ti(IV) > In(III) > Ga(III) > Al(III) > Be(II) > Pd(II) > Co(III) > Si(IV) > Ge(IV) > Cr(III) gives an overall order of lability of these metal ions toward isotopic exchange. It is observed, however, that: (i) mechanism of their intermolecular isotopic exchange differs from one another (ii) so-called substitution labile ions give a slow reaction rate under certain conditions (iii) some of the complexes have dominating associative route for isotopic exchange and (iv) the above sequence does not necessarily reflect the ease of bond-break of metal-ligand bond. (INIS)

32567 ALLOWED AND FORBIDDEN REACTION PATHS FOR THE $H_2 + D_2$ EXCHANGE REACTION. Wright, J. S. (Carleton Univ., Ottawa). Can. J. Chem.; 53: No. 4, 549-555(15 Feb 1975).

Symmetry arguments and ab initio s.c.f. calculation (double-zeta basis set) are used to show that the exchange reaction $H_2 + D_2 \rightarrow 2HD$ could proceed in a concerted fashion through a six-center transition state. The computed barrier height of 90 kcal/mol for this process lies below the experimental dissociation energy of H_2 (but above the computed dissociation energy) and also below the energy required for exchange through a four-center transition state. Either the termolecular (2 + 2 + 2) or bimolecular (4 + 2) cycloadditions are thermally allowed. The presence of a transition metal would allow the reaction to proceed through a four-center geometry, leading to the formation of a possible stable metal-H_4 complex. (auth)

32568 ADSORPTION, DESORPTION, AND EXCHANGE REACTIONS OF OXYGEN, HYDROGEN, AND WATER ON PLATINUM SURFACES. II. Hydrogen Adsorption, Exchange, and Equilibrium. Peng, Y. K.; Dawson, P. T. (McMaster Univ., Hamilton, Ontario). Can. J. Chem.; 53: No. 2, 298-306(15 Jan 1975).

The adsorption, desorption, exchange, and equilibration reactions of hydrogen and deuterium on a platinum filament were investigated by thermal desorption mass spectrometry. A surface saturated with hydrogen at 120°K has a coverage 4.2×10^{14} molecules cm^{-2} and gives desorption spectra with four distinct peaks: β_1 (165°K), β_2 (220°K), β_3 (280°K), and β_4 (350°K). Apparent activation energies and pre-exponential factors were determined for the β_2-, β_3-, β_4-peaks. For both co-adsorption and sequential adsorption of H_2 and D_2 the mass 2, 3, and 4 desorption spectra have identical shapes and the gas desorbs at equilibrium throughout. It is concluded that hydrogen adsorbs dissociatively. Exchange and equilibration were studied at 120, 210, and 285°K by determining the surface composition and isotope distribution after varying fractions of preadsorbed H had been replaced. Following exchange at 120°K the desorption spectra show a higher D content and a lack of equilibrium in the desorbing gas at low temperature. In most other experiments the mass 2, 3, and 4 desorption spectra had identical shapes and the gas desorbed at equilibrium. The results are interpreted by a model which requires that the polycrystalline platinum surface is intrinsically heterogeneous. It appears that different mechanisms are unnecessary to interpret the differences in kinetics observed for exchange and equilibration at low temperatures. (auth)

32569 BUFFER DEPENDENCE OF CARBONIC ANHYDRASE CATALYZED OXYGEN-18 EXCHANGE AT EQUILIBRIUM. Silverman, D. N.; Tu, C. K. (Univ. of Florida, Gainesville). J. Amer. Chem. Soc.; 96: No. 8, 2263-2269(16 Apr 1975).

The carbonic anhydrase (human C and bovine) catalyzed rate of exchange of oxygen-18 between bicarbonate and water was measured at chemical equilibrium with and without buffers. An increase of the buffer 1,2-dimethylimidazole ($pK_a = 8.3$) from 0 to 10 mM was accompanied by an enhancement of up to 80% in the rate of catalyzed oxygen-18 exchange near pH 8.3; this enhancement diminished as pH increased. However, the rate of exchange was not further enhanced by the addition of buffer beyond a 10 mM concentration. Similar effects were observed using tris sulfate. The addition of these buffers had no influence on the uncatalyzed rate of oxygen-18 exchange. Furthermore, 1,3-dimethylimidazolium sulfate and pyrrole, which are not buffers in the pH range studied, did not increase the carbonic anhydrase catalyzed exchange rate. Ionic strength was held constant in all experiments using Na_2SO_4; bicarbonate concentrations were as low as 0.5 mM, and enzyme was 5×10^{-9} M. We interpret these results as evidence for the involvement of a buffer-assisted proton transfer in the hydration-dehydration mechanism of carbonic anhydrase. In the absence of added buffers, the enzymatic rate is determined by alternating hydration-dehydration steps at equilibrium, which do not require proton transfer to the enzyme. In addition, bicarbonate itself may act as a buffer. As the buffer

concentration is increased, the exchange data show a change in the rate-determining step. In the region of low buffer concentration, proton transfer is rate limiting and the catalytic exchange rate increases as buffer increases. Near 10 mM buffer, the maximum enzyme activity is reached and further buffer does not affect the catalytic rate. (auth)

32570 ETHYL TRICHLOROACETATE HYDROLYSIS. II. Oxygen-18 Exchange Accompanying the Water-Catalyzed Hydrolysis. Kurz, J. L.; Wexler, D. N. (Washington, Univ., St. Louis). J. Amer. Chem. Soc.; 96: No. 8, 2255-2258(16 Apr 1975).

Values of k_e/k_h (the oxygen-18 exchange/hydrolysis rate constant ratio) have been measured as a function of temperature for the water-catalyzed hydrolysis of ethyl trichloroacetate in dilute aqueous solution. It was found that $k_e/k_h = 1.59 \pm 0.03$ (25°), $\Delta H_e^{\ddagger} - \Delta H_h^{\ddagger} = -1.7 \pm 0.3$ kcal mol^{-1} and $\Delta S_e^{\ddagger} - \Delta S_h^{\ddagger} = -5 \pm 1$ cal deg^{-1} mol^{-1}. This is the first report of a carboxylic ester for which $k_e > k_h$; the contrary order reported for other esters may arise from the fact that most previous studies of ester exchange and hydrolysis have used mixed solvents. Comparison of this 25° value of k_e/k_h to the kinetically measured value of k_{-1}/k_2 (the rate constant ratio for partition of the intermediate between elimination of water and elimination of ethanol, respectively) implies that proton transfer to the initially formed anionic intermediate is faster than elimination from that intermediate and allows calculation of the following parameters for that partition: $k_{-1}/k_2 = 3.18 \pm 0.06$ (25°); $\Delta H_{-1}^{\ddagger} - \Delta H_2^{\ddagger} = -1.7 \pm 0.3$ kcal mol^{-1}; $\Delta S_{-1}^{\ddagger} - \Delta S_2^{\ddagger} = -3 \pm 1$ cal deg^{-1} mol^{-1}. (auth)

32571 INVESTIGATION OF THE KINETICS OF BASIC DEUTEROEXCHANGE OF 2-METHYL, 2-PHENYL, 2- AND 5-BENZYL-3-HYDROXYPYRIDINES, AND THEIR N-OXIDES BY THE PMR METHOD. Lezina, V. P.; Stepanyants, A. U.; Zhuravlev, V. S.; Smirnov, L. D.; Dyumaev, K. M. (Inst. of Chemical Physics, Moscow). Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 23: No. 7, 1420-1423(Jul 1974).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 23: No. 7, 1498-1502(Jul 1974).

The sequence and rate of exchange of various protons of the β-pyridol ring were investigated in 3-hydroxypyridine, 2-methyl-, 2-phenyl-, 2- and 5-benzyl-3-hydroxypyridines, and their N-oxides, with the aid of basic deuteroexchange. Replacement of a methyl group by a benzyl group and then by a phenyl group is accompanied by a gradual decrease in the reactivity of the β-pyridol ring in basic deuteroexchange. The introduction of an N-oxide group accelerates the exchange of the protons in the β-pyridol ring, especially in the α-positions. (auth)

32572 CLOSED LOOP REFLUX SYSTEM. De Witt, R.; Jepson, B. E.; Schwind, R. A. (to United States Energy Research and Development Administration). US Patent 3,869,255. 4 Mar 1975. Filed date 10 Jan 1973. 8p.

Sulfur isotopes are continuously separated and enriched using a closed loop reflux system wherein sulfur dioxide (SO_2) is reacted with sodium hydroxide (NaOH) or the like to form sodium hydrogen sulfite ($NaHSO_3$). Heavier sulfur isotopes are preferentially attracted to the $NaHSO_3$, and subsequently reacted with sulfuric acid (H_2SO_4) forming sodium hydrogen sulfate ($NaHSO_4$) and SO_2 gas which contains increased concentrations of the heavier sulfur isotopes. This heavy isotope enriched SO_2 gas is subsequently separated and the $NaHSO_4$ is reacted with NaOH to form sodium sulfate (Na_2SO_4) which is subsequently decomposed in an electrodialysis unit to form the NaOH and H_2SO_4 components which are used in the aforesaid reactions thereby effecting sulfur isotope separation and enrichment without objectionable loss of feed materials. (Official Gazette)

32573 STABLE ISOTOPE FRACTIONATION BY CLOSTRIDIUM PASTEURIANUM. I. $^{34}S/^{32}S$: Inverse Isotope Effects During SO_3^{2-} and SO_4^{2-} Reduction. McCready, R. G. L.; Lalshley, E. J.; Krause, H. R. (Univ. of Calgary, Alberta). Can. J. Microbiol.; 21: No. 3, 235-244(Mar 1975).

During growth on minimal salts–sucrose media supplemented with various concentrations (10^{-4}-10^{-2} M) of sodium sulfate, Clostridium pasteurianum grew at a normal rate and only evolved sulfide in late stages of growth on 10^{-2} M SO_4^{2-}. The evolved sulfide was slightly enriched in ^{34}S as compared to the medium sulfur. On the other hand, sulfide was evolved during growth on all concentrations of sulfite tested. Large normal and inverse isotopic effects were observed in the evolved sulfide during SO_3^{2-} reductions. In contrast, the intracellular sulfur showed much smaller fractionations. The complexity of the isotopic patterns suggests that a dissimilatory sulfite reductase system may be induced by high concentrations of sulfite. (auth)

Feed Materials Processing

Refer also to abstract 32491.

32574 RADIOMETRIC SEPARATION OF URANIUM ORE MINERALS WITH ANALOG EVALUATION OF DETECTED PULSE RATE. Hejtman, J. (Vyvojovy Zavod Uranoveho Prumyslu, Kamenna (Czechoslovakia)). Rudy (Prague); 21: No. 11, 363-367 (Nov 1973). (In Czech).

An analog method is described of evaluating the detected pulse rate. Relations are derived for the probability of taking grains of uranium ore minerals for the enriched product in dependence on the parameters of the uranium ore minerals, the separation machine, and the technological regime. A program was written for the ORDA-1204 computer for computing the technological results of separation. The comparison of computed data with the results of operation confirmed that the new method of computation was considerably more accurate. (INIS)

32575 STOCHASTIC MODEL OF RADIOMETRIC SEPARATION OF URANIUM ORES. Hejtman, J. (Vyvojovy Zavod Uranoveho Prumyslu, Kamenna (Czechoslovakia)). Rudy (Prague); 21: No. 8, 249-252(Aug 1973). (In Czech).

A theoretical model of radiometric separation of uranium ores is presented as was developed by the Development Plant of the Czechoslovak Uranium Industry at Kamenná. A relation is formulated between the probability of collecting grains of standard equivalent E_m (mgs of uranium in standard) for the enriched product and the radiometric switching level I_s (imp.s^{-1}), depending on the parameters of the separator, the parameters of the separated ores, and the hour output of the radiometric separator. A program was written in the ALGOL-60 language for the ODRA-1204 computer. Computed distribution curves are presented for ores of mean metallic content of 100 units and contrast ratios of M = 1.2 and 1.8, and for ores of mean metallic content of 1000 units and a contrast ratio of M = 1.8. The curves also show the effect of the hour output of the separator. (INIS)

32576 A SIMULATION PROCEDURE FOR DETERMINING THE DISTRIBUTION CURVES IN RADIOMETRIC SEPARATION. (Part II). Halik, L. (Uranove Doly, Dolni Rozinka (Czechoslovakia). Odstepny Zavod). Rudy (Prague); 22: No. 2, 36-41(Feb 1974). (In Czech).

A method is described based on simulation. It permits computation of estimated results of radiometric separation without the usual long and costly technological tests. All that is needed is the knowledge of the characteristics of the ore mineral and the separation equipment. Under study was the effect of background noise, grain size distribution, weight, the speed of the conveyor belts, the number of pieces in the dose, and of the combinations of all the mentioned factors. (INIS)

Radiation Chemistry

Refer also to abstracts 32619, 32623, 32636, 33374, 33379, 33386, 33418, 34034, 34035, 34053, 34056, and 34068.

32577 (COO-2410-1) LASER PHOTOLYSIS STUDIES ON THE STRUCTURE AND PHOTOEXCITED STATES OF SOLVATED ELECTRONS. Final Report, November 1, 1973–December 31, 1974. Kenney-Wallace, G. A. (Yale Univ., New Haven, Conn. (USA)). 1974. Contract AT(11-1)-2410. 27p. Dep. NTIS $4.50.

The assembly of a high-powered, Q-switched Ruby laser-dye laser photolysis system was completed in order to make measurements of the solvation times and excited state lifetimes of solvated electrons in alcohols, employing laser saturation spectroscopy. Preliminary results are reported from laser saturation studies at 694 nm of solvated electrons in ethanol and 2-propanol. The solvated electrons (e_s^-) were generated via the two-photon ionization of selected arenes (such as pyrene) in alcohol at 347 nm. The results are interpreted in terms of a two-level saturable absorber and upper limits on the excited state lifetimes of e_s^- are calculated. Solvation times of e_s^- in long chain alcohols, measured independently in picosecond pulse radiolysis, showed that the time taken for the electron population to reach a fully relaxed, solvated ground state increased as the length of the alcohol chain increased, each e_s^- spectrum exhibiting a significant blue shift during the initial 10^{-10}s. The implications of the excited state lifetime data, solvation measurements, and trends in the relative $G\epsilon$ values at times $\ll 10^{-9}$s, will be discussed in the context of electron models. Qualitative conclusions may be drawn on the nature of the electron trapping site and the solvation process in long-chain alcohols. (auth)

32578 (JAERI-M-5567, pp 68-73) RADIATION CHEMISTRY IN THE HIGH LET REGION. Some Aspects of Heavy-Ion Radiolysis. Imamura, M. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Some aspects of the heavy-ion radiolysis studies are reviewed from a viewpoint of the LET effect in radiation chemistry. Discussions are given of the track structure of heavy ions and the results for aqueous solutions and liquid organic substances including aliphatic ketones. (auth)

32579 (JAERI-M-5567, pp 81-86) SPATIAL DISTRIBUTION OF FREE RADICALS PRODUCED IN HEAVY ION RADIOLYSIS OF ORGANIC CRYSTALS AT 77°K. Kimura, K. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Spatial distributions of trapped fragment free radicals were studied by measuring the linewidths and power saturation in ESR spectra after the irradiation with ^{4}He, ^{12}C, and ^{14}N ions at 77°K. The irradiating particles were accelerated with IPCR cyclotron. The single crystals subjected to the radiolysis were n-eicosane ($C_{20}H_{42}$) (I), malonic acid(II), and trihydrated sodium acetate(III). The radicals produced in heavy ion radiolysis of (I) and (II) can be assignable to the same one as in γ radiolysis and have broader ESR line widths and show difficulty for power saturation. These facts mean that the spin-spin interaction of the radicals trapped in the heavy ion radiolysis is stronger than that in the γ radiolysis, namely higher spatial distribution of radicals are expected. As for (III), the characteristic reactions were considered in the vicinity of heavy ion tracks by comparing the ESR spectra measured in the γ and heavy ion radiolysis. (auth)

32580 (JAERI-M-5567, pp 87-94) SOME ASPECTS OF LET EFFECT ON RADIATION-CHEMICAL REACTIONS. Matsuura, T. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Three new aspects are proposed in the aim of understanding the LET effect on various radioinduced reactions. The scope of radiation-chemical reaction considered should be extended to include the photographic reactions, solid state track detector reaction, and even the scintillation and thermoluminescence phenomena. Various patterns of LET effect are shown and discussions were made on the origin of these effects, i.e., while the higher LET radiation may only possibly favor the reactions of high threshold, it should favor the reactions of high activation energies. In this respect, the role of hot atoms should be considered in radiation-chemical reactions especially induced by high LET radiations such as by heavy ions. (auth)

32581 (JAERI-M-5567, pp 99-102) FORMATION OF SUB-MICRON HOLES IN IRRADIATED POLYETHYLENETEREPHTHALATE FILMS BY CHEMICAL ETCHING. Tsujimura, S.; Komaki, Y. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Thin polyethyleneterephthalate films exposed to fission fragments of U-235 were chemically etched by NaOH solutions and the growth of holes was followed by measuring gas flow through the films. Frontal and lateral etching rate of holes were determined under etching temperature of 45 to 65°C and NaOH concentration of 1 to 5 N. (auth)

32582 (JAERI-M-5825) CONTROL OF RADIATION-INDUCED POLYMERIZATION BY DOSE-RATE REGULATION. 3. Hashimoto, S.; Kawakami, W.; Akehata, T. (Japan Atomic Energy Research Inst., Tokyo). Aug 1974. 26p. (In Japanese). INIS.

Control of the radiation-induced polymerization of MMA by on-off regulation of the dose rate was studied theoretically and experimentally for the case of a pseudo steady-state of the radical concentration. Controlability of the reaction temperature in C.S.T.R. and the influence of dose-rate regulation on molecular weight distribution of the polymer are described. The reaction temperature responded sensitively to the dose rate. Reactor control of high quality is possible by dose rate regulation. Reactor control in set point T_s by on-off regulation of the dose rate is possible if the two limits of dose rate I_H and I_L are $I_H > I_S > I_L$; I_S is the dose rate to give steady operation of the reactor at T_S in continuous irradiation and it is determined by the operating conditions. The on-off control with dead time results in periodical irradiation between I_H and I_L. Molecular weight distribution of the polymer varies from unimodal to bimodal according to the values of I_H, I_L and I_S. (auth)

32583 (ORO-4179-37) RADIOLYTIC INVESTIGATIONS OF MICELLAR AND MACROMOLECULAR SYSTEMS. Annual Progress Report, April 1, 1974-March 31, 1975. Fendler, J. H. (Texas Agricultural and Mechanical Univ., College Station (USA). Dept. of Chemistry). 1975. Contract AT(40-1)-4179. 24p. Dep. NTIS $4.25.

This fourth Annual Report on "Radiolytic Investigations of Micellar and Macromolecular Systems" lists the personnel, journal publications and oral presentations in addition to summarizing the scientific activities for the period April 1, 1974-March 31, 1975. Techniques for the determination of fluorescence lifetimes in the nanosecond region and the subsequent mathematical analysis of the data were established. By using nanosecond fluorescence lifetime measurements, information on the structure of reversed micellar polyoxyethylene(6) nonylphenol and on energy transfer in dodecylammonium propionate aggregates were obtained. Research was initiated in the use of reversed micelles and liposomes as membrane models. Attention was focused on optimizing the parameters that influence liposome formation and substrate entrapment therein. Interaction of thymine with micellar N-decanoyl-DL-cysteine was investigated by ^{1}H nmr. Radiation-induced radical processes of duroquinone were investigated in aqueous micellar solutions. (auth)

32584 (RRL-3238-497) QUARTERLY REPORT, JULY 1, 1974-SEPTEMBER 30, 1974. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)). 4 Oct 1974. Contract AT(11-1)-3238. 21p. Dep. NTIS $4.25.

Investigations in progress include: alkoxy and other radicals produced from alcohols as studied by spin trapping; ESR studies of the effects of carboxylation on the electron distribution in cyclohexadienyl and hydroxycyclohexadienyl radicals; rate constants for reaction of O^- radicals with aromatic compounds; pulse radiolytic study of single-electron redox potentials; reactivity of $\cdot SO_3^-$ radical anion with pyrimidines; optical pulse radiolytic studies on aqueous solutions of glycerol and β-glycerophosphate; hydroxylation of benzoic acid; reactions of e_{aq}^- with nitrobenzyl halides in aqueous solution; pulse radiolysis studies on vitamin K in aqueous and micellar solutions; and pulse radiolysis studies on folic acid. Abstracts of the following reports that were issued during the quarter are included: ESR Evidence Regarding the Structures of Some Simple Nitrogen-Centered Radicals in Aqueous Solution; Hydroxyl Radical Induced Oxidation of Nitrobenzene; Dissociation of Hydroxyl Protons of β-Hydroxyalkyl Radicals as Studied by Electron Spin Resonance; ESR Study of the Sulfide Radical Adducts to Unsaturated Compounds; Behavior of Hydrated Electrons in CTAB Micellar Solution; Quenching of Aromatic Hydrocarbon Fluorescence by Cesium Chloride; and Application of Radiation Techniques to Physical Organic Chemistry. (LK)

32585 (RRL-3238-508) QUARTERLY REPORT, OCTOBER 1, 1974-DECEMBER 31, 1974. (Mellon Inst. of Science, Pittsburgh (USA). Radiation Research Labs.). 16 Jan 1975. Contract AT(11-1)-3238. 27p. Dep. NTIS $4.50.

Abstracts of the following reports issued during the quarter are included in the progress report: Photo-reduction of Hydrogen Peroxide by Hydrogen; Oxidation of Phenol to Phenoxyl Radical by O^-; ESR Spectra of the Carboxylated Cyclohexadienyl Radicals: ^{13}C Hyperfine Constants and the Effect of Carboxylation on the g Factors and Proton Hyperfine Constants; Hydroxyl Radical Induced Oxidation of Nitrobenzene; Electron Spin Resonance Study of Radicals Produced in Irradiated Aqueous Solutions of Aliphatic Hydrocarbons; ESR Studies of Phenyl and Pyridyl Radicals in Aqueous Solution; The Amplification Before Decay of Perturbations Around Stable States in a Model of the Zhabotinskii Reaction; One Electron Transfer Equilibria and Redox Potentials of Radicals Studied by Pulse Radiolysis; and One-Electron Redox Potentials of Nitro Compounds and Radiosensitizers: Correlation with Spin Densities of their Radical Anions. Progress is reported in the following studies: short-time behavior of ESR signals in pulse experiments; ESR study of dissociation of NH protons of peptide radicals; oxidation of phenol by SO_4^-; liquid chromatographic studies of the hydroxylation of benzoic acid; reaction of O^- radicals with aromatic compounds; radiation chemistry of potassium hexathiocyanatochromate(III), $K_3Cr(SCN)_6$; use of Tl as a radical scavenger; concentration dependence of the electron scavenging process; further investigations of models of the oscillatory Belousov-Zhabotinskii reaction; and application of numerical integration to the analysis of complex chemical mechanisms. (LK)

32586 DECOMPOSITION OF ALDRIN BY GAMMA RADIATION. I. In Organic Solvents. Carp, A. E.; Liska, B. J.; Ziemer, P. L. (Purdue Univ., Lafayette, IN). Bull. Environ. Contam. Toxicol.; 7: No. 6, 321-330(Jul 1972).

The effect of gamma radiation on aldrin dissolved in hexane, acetone, and cyclohexane was studied. Results showed that the extent of aldrin degradation and the number of isomers produced by the radiation varied with the absorbed dose of gamma radiation, the concentration of the aldrin, the solvent used to dissolve

the pesticide, and the temperature at which irradiation occurred. (LK)

32587 DECOMPOSITION OF ALDRIN BY GAMMA RADIATION. II. In Lipid Solutions. Carp, A. E.; Liska, B. J.; Ziemer, P. L. (Purdue Univ., Lafayette, IN). Bull. Environ. Contam. Toxicol.; 7: No. 6, 331-337(Jul 1972).

The effect of gamma radiation on aldrin dissolved in corn oil and lard was studied. Conditions used in packing, irradiating, and storing the samples were varied. The only treatment which produced any major alteration of the amount of isomers formed was the temperature at which irradiation was accomplished. (LK)

32588 RADIATION CHLORINATION OF POLYETHYLENE IN CCl_4 SOLUTION. Korolev, B. M.; Kosortov, V. I.; Kirillov, A. N.; Egunov, A. V.; Chertorizhskii, A. V.; Dzhagatspanyan, R. V. Vysokomol. Soedin., Ser. A; 16: No. 12, 2725-2729(Dec 1974). (In Russian).

A study was carried out of the radiation chlorination of polyethylene in CCl_4 solution at various gamma dose rates, mass gas flow and volume of solution to be chlorinated. The optimal conditions for carrying out the process were found to be: gamma dose rate of 0.5 rad/sec and a distribution of gas flow along the diameter of the reactor tube that takes into account the change in radiation dose. Mathematical equations satisfactorily describing the process are presented for the chlorination of polyethylene in solution. (SJR)

32589 NANOSECOND PULSE RADIOLYSIS OF STYRENE IN AQUEOUS SOLUTIONS. Brede, O.; Helmstreit, W.; Mehnert, R. (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). J. Prakt. Chem.; 316: No. 3, 402-414(1974). (In German).

The absorption spectra of water radiolysis radical addition products with styrene are given. The radicals H, OH, and e_{aq} react for the most part with the olefin group of styrene. The rate constants of the reactions investigated are determined and quantitatively interpreted by HMO calculations. (INIS)

32590 RADIATION COPOLYMERIZATION OF 2-HYDROPENTAFLUOROPROPYLENE WITH VINYLIDENE FLUORIDES. Usmanov, Kh. U.; Yul'chibaev, A. A.; Mukhamadaliev, N.; Sarros, T. K. (Tashkent State Univ.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 18: No. 3, 464-466(1975). (In Russian).

The kinetics of the radiation copolymerization of 2-hydropentafluoropropylene with vinylidene fluorides at 90 R/sec was studied at different monomer ratios and temperatures. It was established that in this system the fluoride is very active. (tr-auth)

32591 APPLICATION OF CALORIMETRY TO RADIATION CHEMISTRY AND RADIATION PHYSICS PROBLEMS. Chapter II. Shimanskaya, N. S. pp 302-312 of Ionizing Radiation Calorimetry. Moscow; Atomizdat (1973). (In Russian).

A short review is presented of the results of using calorimeters for investigating the polymerization and radiolysis of hydrocarbons. A description is given of calorimetric methods of measuring energy stored on irradiating a substance with ionizing radiation, in particular, the energy accumulated in graphite during reactor irradiation. (tr-INIS)

32592 MECHANISM OF HIGH-ENERGY-INDUCED LUMINESCENCE OF SOLID 2,3-DIMETHYLBUTANE CONTAINING TOLUENE AT 77K. Miyazaki, T.; Fujitani, Y.; Kuri, Z. (Nagoya Univ. (Japan). Faculty of Engineering). Bull. Chem. Soc. Jap.; 47: No. 5, 1070-1074(May 1974).

The luminescence from 2,3-dimethylbutane (23DMB) containing a small amount of toluene (To) was observed in the solid phase at 77°K during γ-irradiation or by ns pulse irradiation with x rays. The emission spectrum from 23DMB-To (2 mole %) during γ-irradiation at 77°K consists of the fluorescence from the singlet-excited toluene and the phosphorescence from the triplet-excited toluene. Both the singlet- and triplet-excited toluenes are formed by the energy transfer from the irradiated 23DMB to toluene. When nitrous oxide or propylene is added to the 23DMB-To mixture, the emission spectrum is changed and becomes very similar to that from the 23DMB-To mixture during illumination with uv radiation at 77°K. The spectrum, which disappears on the addition of nitrous oxide or propylene, consists mainly of phosphorescence. Triplet-excited toluene may be formed by the migration of a hole and an electron. The effects of electron scavengers, such as nitrous oxide and carbon dioxide, or hole scavengers, such as propylene or tetramethylethylene, on the fluorescence were studied by nsec-pulse irradiation. Since the fluorescence is not appreciably affected by the addition of these scavengers, the singlet-excited toluene may be formed by the excitation transfer. (auth)

32593 EXHAUST GAS PROCESSING STUDY BY ELECTRON BEAM IRRADIATION. I. Exhaust Gas Processing With Batch Type Apparatus. Kawamura, K.; Aoki, S. (Ebara Mfg. Co. Ltd., Tokyo (Japan)). FAPIG (Tokyo); No. 3, 28-33(Jun 1974). (In Japanese).

Results of electron-beam irradiation applied with a batch-type apparatus to the exhaust gas of heavy oil combustion are described, as the first stage of the application study of radiation to exhaust gas processing. Electron energy was attenuated to proper value by changing the thickness of an Al front cover of a gas container. Combustion gas of type B fuel oil was used as sample gas. A burner was improved to completely burn the oil over a long time. With the sample gas, SO_2 content was measured by means of a Kitagawa type detector tube before and after irradiation. The components of the white smoke-like aerosol generated in the sample gas due to the irradiation of electron beam were analyzed with a fluorescent x ray analyzer, an infrared spectrometer, and a CHN coder. Sulfur dioxide concentration was reduced rapidly when combustion gas was irradiated with an electron beam. The reduction ratio was affected by initial concentration, reaction temperature, and electron energy, and the lower the conditions, the better the ratio. For an example, 80% reduction was obtained at the SO_2 concentration of 1000 ppM, 100°C, and 2.6 Mrad. (JA)

32594 INFLUENCE OF IMPURITIES ON RADIATION-CHEMICAL PROCESSES IN CRYSTALS OF INORGANIC SALTS. Gromov, V. V. (AN SSSR, Moscow. Inst. Fizicheskoj Khimii). Usp. Khim.; 43: No. 2, 201-223(Feb 1974). (In Russian).

For English translation see the journal Russ. Chem. Rev.

Radiation processes are analyzed in crystals of inorganic salts having a complex anion (nitrate, sulfate, oxyhalide, etc.), which contain various chemical impurities. Consideration is given to the effect of crystallization water on the mechanism of radiolysis and radiation stability of an inorganic compound. Discussion is devoted to the role of heterophase additives (mixtures of inorganic substances), conditions of irradiation with gamma rays, and the mechanism of radiation energy transfer in irradiated systems. An estimate is given of the contribution of various factors (ionization potential of the ions in the crystal lattice, electron affinity of radiolysis products, crystal lattice parameters, electrophysical properties of the impurities and others) during radiolysis of inorganic salts. Possible methods of regulating the radiation stability of irradiated substances are discussed. (tr-auth)

32595 RADIOLYSIS OF AQUEOUS SOLUTIONS OF SUGAR PHOSPHATES. Kochetkov, N.; Kudrjashov, L. I.; Chlenov, M.; Grineva, L. P. (N. D. Zelinsky Institute of Organic Chemistry, Academy of Sciences, Moscow (USSR)). Carbohyd. Res.; 35: 235-241(Jul 1974).

The mechanism of the radiation-induced dephosphorylation reaction was investigated by studying the gamma-radiolysis of 10 mM solutions of D-glucopyranosyl phosphate, D-glucose 6-phosphate (Glc-6-P), and D-ribose 5-phosphate (Rib-5-P). Dephosphorylation occurred with DH-radical participation, since $G(H_3PO_4)$ values for nitrous oxide-saturated solutions were 4.1, 1.7, and 2.3 and for nitrogen-saturated solutions 2.6, 1.1, and 1.6, respectively. The formation of phosphate-free compounds accompanied the release of inorganic phosphate. The main, neutral products of the radiolysis of Glc-6-P were 6-deoxyhexos-5-ulose (G = 0.2) and D-gluco-hexodialdose (G = 0.3). Irradiation of Rib-5-P gave ribo-pentodialdose and 5-deoxypentos-4-ulose as the main, neutral products. A scheme for the dephosphorylation process is proposed. (INIS)

32596 STUDIES ON THE CATALYTIC ACTIVITY OF WATER FROM WEAKLY RADIOACTIVE SOURCES. Part 1. Influence of Weakly Radioactive Water on the Peroxidative Oxidation of Indigo-Carmin. Szmytowna, M.; Umbreit, M. H. (Akademia Medyczna, Poznan (Poland)). Ann. Pharm. (Poznan); 10: 51-57(1973). (In Polish).

Peroxidative oxidation of indigocarmin is studied, using H_2O_2, versus the time and radiation dose ($0.6 - 4.8$ mμ Ci/dcm^3) originating from radium and decay products of ^{226}Ra. The peroxidative oxidation rate of indigocarmin decreased with increasing dose of the radioactive substance; a dose of as little as 0.6 mμ Ci/dcm^3 is sufficient to influence the course of the process. (auth)

32597 RADIATION STERILIZATION OF DEXTRAN IRRADIATED IN DRY STATE. Bachman, S.; Zegota, A.; Zegota, H. (Politechnika Lodzka (Poland). Instytut Techniki Radiacyne j). Probl. Tech. Med.; 4: 331-337(1973). (In Polish).

From 3rd symposium of Polish Medical Physics Society; Zabrze, Poland (10 May 1972).

The effect of ionizing radiation gamma ^{60}Co was examined in the aspect of certain physico-chemical changes occurring in irradiated dextran. The dose ranged between 0.5 and 5.0 Mrad. Changes in pH, optical rotation, buffer capacity, quantity of reducing sugars, and oxalic acid were observed. The viscosity of solutions and a decrease of the mean molecular weight of the irradiated dextran may serve as a proof of radiation degradation of the macromolec-

ules. In the course of storage of the irradiated dextran post-irradiation processes occur which can be demonstrated, among others by the decrease of pink coloration of the samples in the course of storage. (auth)

32598 ESR EVIDENCE FOR THE RADIATION-INDUCED BREAKAGE OF THE SUGAR-PHOSPHATE BONDS IN NUCLEOTIDES: SINGLE CRYSTAL OF DEOXYCYTIDINE 5′-MONOPHOSPHATE. Krilov, D.; Herak, J. N. (Institut Rudjer Boskovic, Zagreb (Yugoslavia)). Biochim. Biophys. Acta; 366: No. 4, 396-401(Nov 1974).

Electron spin resonance was used for identification of radicals in gamma-irradiated single crystal of deoxycytidine 5′-monophosphate monohydrate. From the number and angular dependence of the proton couplings, the $=C(4')-\dot{C}(5')-H_2(5')$ radicals have been identified. These radicals are formed by the breakage of the sugar-phosphate bond. (INIS)

32599 POLYMER REACTIONS ON POWDER SURFACES. Kroker, R.; Khamann, K.; Shnejder, M. Usp. Khim.; 43: No. 2, 349-369(Feb 1974). (In Russian).

For English translation see the journal Russ. Chem. Rev. Translated from Progr. Org. Coatings; 1: No. 23(1972).

The possibilities and outlook for polymeric reactions on the surfaces of solid substances are considered. Consideration is given to polymer reactions on solid surfaces initiated by mechanical-chemical processes, polymerization initiated by radiation (by beta and gamma irradiation), polymer reactions on surfaces of carbon black and graphite, and reactions on solid surfaces whose functional groups can participate in processes of homo- and copolymerization. Discussion is devoted to proposed mechanisms of these reactions and the effect of various fillers and other factors on the process and the properties of reinforced materials which are obtained. Results of the studies considered in the review indicate the broad possibilities of carrying out polymerization reactions on solid surfaces. (tr-auth)

32600 EFFECTS OF SOLUTES, DEUTERATION, AND ANNEALING ON THE PRODUCTION AND DECAY OF RADICALS IN γ-IRRADIATED 3-METHYLPENTANE GLASSES. Neiss, M. A.; Willard, J. E. (Univ. of Wisconsin, Madison). J. Phys. Chem.; 79: No. 8, 783-794(10 Apr 1975).

Understanding of the mechanisms of radical production and decay in γ-irradiated hydrocarbon glasses, and in γ-irradiated and photolyzed solutions of alkyl halides in such glasses, has been extended through studies of yields and decay rates in 3-methylpentane (3MP) and 3MP-d_{14}, with and without charge scavengers, using ESR as the detection technique. About half of the C_6H_{13} radicals produced by γ irradiation of pure 3MP decay at 77°K by relatively fast intraspur radical–radical reaction with time-dependent first-order kinetics. The remainder decay with second-order kinetics ($k = 1.6 \times 10^{-25}$ cm^3 molecule^{-1} sec^{-1}), by reaction following random diffusion ($D \simeq 9.0 \times 10^{-20}$ cm^2 sec^{-1}). Changes in resolution of the ESR spectra of trapped C_6H_{13} radicals during decay and during and following photolysis reflect changes in spacing and geometry. The G value for radical production (radicals per 100 eV absorbed) in 3MP at 77°K is 3.0 ± 0.3, while $G(C_6D_{13})$ from the radiolysis of 3MP-d_{14} is 2.0 ± 0.4. $G(C_6H_{13})$ in 3MP-h_{14} and $G(C_6D_{13})$ in 3MP-d_{14} are lowered by electron scavengers, implying that part of the radical formation in the pure hydrocarbons results from electron capture by cations (unless the additives are unexpectedly effective as energy scavengers). Scavengeable electron yields are higher in C_6D_{14} glass than in C_6H_{14}, which is an unexpected matrix isotope effect. $G(C_6H_{13})$ and $G(C_6D_{13})$ from radiolysis of 3MP-h_{14} and 3MP-d_{14} glasses are increased by the presence of 1 mol % hydrogen halide, implying that hot H atoms produced from the halides by dissociative electron capture abstract H (or D) from the matrix. The energetics require capture of electrons with greater than thermal energy. In 3MP-1% HI and 3MP-1% HBr systems, ~70% of the radicals decay by the $C_6H_{13} + HX \rightarrow C_6H_{14} + X$ reaction, the estimated rate constant and HI diffusion coefficient for the HI system being 8.5×10^{-9} M^{-1} sec^{-1} and 1.6×10^{-19} cm^2 sec^{-1}, respectively. HCl forms a stable complex with C_6H_{13} radicals (presumably $C_6H_{13} \cdot HCl$), which can be photochemically decomposed regenerating the original radicals. Alkyl radicals produced in 3MP-d_{14} by dissociative electron capture by alkyl chlorides decay faster than identical radicals produced from bromides and iodides, whereas the rates in 3MP-h_{14} are independent of the geminate halide ion, consistent with recent evidence that the decay mechanisms of CH_3 are different in the two matrices. Photolysis of CH_3I in 3MP-h_{14} produces C_6H_{13} (by abstraction of H by hot CH_3), but no trapped CH_3 radicals. The photolysis of CH_3I in 3MP-d_{14} yields $[CH_3]/[C_6D_{13}] = \sim 0.02$. CH_3 produced photolytically in 3MP-d_{14} decays faster than CH_3 produced by dissociative electron capture, implying that geminate recombination with I is faster than with I$^-$. (auth)

32601 KINETIC STUDIES IN BILE ACID MICELLES. Chen, M.; Graetzel, M.; Thomas, J. K. (Univ. of Notre Dame, IN). J. Amer. Chem. Soc.; 97: No. 8, 2052-2057(16 Apr 1975).

Pyrene is solubilized in aqueous solutions of sodium taurocholate (NaTC) micelles and excited by a frequency doubled ruby laser pulse. The kinetics of the pyrene fluorescence decay are studied in the presence of nonionic and ionic quenchers. These data yield information about the permeability of the NaTC micelles with respect to various quenching solute molecules. While a neutral molecule such as oxygen readily penetrates into the micelle, the entry of iodide ions is inhibited by the negative micellar surface charge. Positively charged quenchers such as Cu^{2+} and Tl^+ are strongly absorbed at the surface of NaTC micelles. This allows for an investigation of the motion of pyrene within a NaTC micelle. The effect of additives such as cholesterol, benzyl alcohol, and Mg^{2+} ions on the permeability of NaTC micelles is also studied. The local viscosity in the interior of NaTC micelles is investigated by fluorescence depolarization measurement using 2-methylanthracene as the photoactive probe. The rotation of this probe within a NaTC micelle is strongly restricted and a microviscosity of 670 cP is derived from the degree of polarization of the emitted light. Mg^{2+} ions, benzyl alcohol, and sodium lauryl sulfate (NaLS) decrease the microviscosity. NaLS exhibits the strongest effect due to efficient comicellization with NaTC. The 347.1-nm laser photolysis of pyrene also produces significant amounts of positive ions and hydrated electrons. While the photoionization cross section in NaTC and NaLS micelles is similar, the lifetime of pyrene cations is much shorter in the former than in the latter type of micelles. This effect may be explained with the destruction of the smaller NaTC micelle by the positive charge. In comicelles of NaLS and NaTC the lifetime of pyrene cations increases rapidly with increasing NaLS content of the micelle. The electrons which are photoejected from the pyrene in the interior of the micelle become hydrated in the surrounding aqueous phase. Hydrated electrons have a low reactivity toward monomer NaTC ($k = 10^8$ M^{-1} sec^{-1}). The reactivity decreases further upon micellization. (auth)

32602 ONE-ELECTRON REDOX REACTIONS OF WATER-SOLUBLE VITAMINS. III. Pyridoxine and Pyridoxal Phosphate (Vitamin B_6). Moorthy, P. N.; Hayon, E. (Army Natick Labs., Natick, MA). J. Amer. Chem. Soc.; 97: No. 8, 2048-2052(16 Apr 1975).

The one-electron reduction of pyridoxine (PH) and pyridoxal phosphate (PPH) in water by hydrated electrons, e^-_{aq}, and acetone ketyl radicals, $(CH_3)_2\dot{C}OH$, was studied using the fast-reaction technique of pulse radiolysis and kinetic absorption spectrophotometry. The reaction rate constants of e^-_{aq}, $(CH_3)_2\dot{C}OH$ and OH radicals with PH and PPH were determined at different pH values consistent with the ionization constants of these substrates. The optical absorption spectra and extinction coefficients of the free-radical intermediates produced from the one-electron reduction of pyridoxine and pyridoxal phosphate were obtained at different pH values. From the change in absorbance with pH at fixed wavelengths, the ionization constants of the radicals were derived. For the pyridoxine intermediate, pK_a values of 4.8 and 11.4 were obtained and the species assigned to $\cdot PH_3^+$, $\cdot PH_2$, and $\cdot PH^-$. The rate of protonation of $\cdot PH_2$ to $\cdot PH_3^+$, by protons was $k = 7.8 \pm 1.0 \times 10^9$ M^{-1} sec^{-1}. In the case of pyridoxal phosphate, pK_a values of 3.7 and 6.9 were obtained for the corresponding radicals $\cdot PPH_3^+$, $\cdot PPH_2$, and $\cdot PPH^-$. For both PH and PPH, the first proton loss in the radical is suggested to come from the ring nitrogen, and the second proton loss from the phenolic hydroxyl group. Support for the latter assignment was obtained from the one-electron reduction of 3-methoxypyridoxal phosphate. The properties of the substrates and of the radicals are discussed on the basis of their redox potentials. (auth)

32603 ELECTRON SPIN RESONANCE STUDY OF THE SULFIDE RADICAL ADDUCTS TO UNSATURATED COMPOUNDS. Kirino, Y.; Fessenden, R. W. (Carnegie–Mellon Univ., Pittsburgh). J. Phys. Chem.; 79: No. 8, 834-839(10 Apr 1975).

Addition of the sulfur-containing intermediate produced by OH reaction with sulfide to a number of unsaturated compounds has been studied by means of ESR spectroscopy. Eight types of compounds were used: aliphatic compounds containing C=C (olefinic compounds and enols), C=C, C=N (oximes and an imine), or C=S bonds, benzenes, furans, pyrroles, and thiophenes. Adduct radicals containing sulfur were detected only in the case of some olefinic compounds and oximes. The lack of detectable lines in the other cases is most likely the result of slow reaction of the intermediate. Values of the pK for dissociation of the sulfhydryl proton in three β-mercaptoalkyl radicals were determined. The values are for $HSCH_2\dot{C}HCO_2^-$, 8.9, for $HSCH_2\dot{C}HCN$, 7.1, and for $HSCH_2\dot{C}(CH_3)CO_2^-$, 9.5. A study of the temperature dependence of line broadening in $^-SCH_2\dot{C}HCO_2^-$

and $^{-}SCH_2\dot{C}(CH_3)CO_2^{-}$ gave values for the activation energy for internal rotation by 180° about the $CH_2-\dot{C}$ bond of 7.1 and 6.2 kcal mol^{-1}, respectively. (auth)

32604 KINETICS OF THE REACTION OF HYDROXYL RADICALS WITH ETHYLENE, PROPYLENE, 1-BUTENE, AND TRANS-2-BUTENE. Pastrana, A. V.; Carr, R. W. Jr. (Univ. of Minnesota, Minneapolis). J. Phys. Chem.; 79: No. 8, 765-770(10 Apr 1975).

The kinetics of the decay of hydroxyl radicals in the presence of ethylene, propylene, 1-butene, and trans-2-butene were studied at approximately 1 Torr and 300°K in a tubular discharge-flow reactor. Hydroxyl radicals were produced by the reaction of atomic hydrogen with nitrogen dioxide, $H + NO_2 = OH + NO$ (1), and their decay was followed by line absorption photometry at 308.328 nm in an excess of olefin. The decays were pseudo-first order, and the kinetics were first order with respect to both hydroxyl and olefin for each of the olefins studied. The second-order rate constants are $nk_{OH+C_2H_4} = (2.13 \pm 0.13) \times 10^{-12}$ cm^3 $molecule^{-1}$ sec^{-1}, $nk_{OH+C_3H_6} = (5 \pm 1) \times 10^{-12}$ cm^3 $molecule^{-1}$ sec^{-1}, $nk_{OH+1-C_4H_8} = (1.5 \pm 0.1) \times 10^{-11}$ cm^3 $molecule^{-1}$ sec^{-1}, and $nk_{OH+trans-2-butene} \cong (1.2 \pm 1) \times 10^{-11}$ cm^3 $molecule^{-1}$ sec^{-1}. The reaction with propylene is susceptible to secondary reactions since n, the stoichiometric coefficient, decreased by a factor of 3.5 as $[C_3H_6]_0/[OH]_0$ increased from 1.5 to 30. The stoichiometric coefficients for the C_2H_4 reaction and the C_3H_6 reaction at the higher (olefin)/(OH) ratios are nearly unity. The reaction with butenes is accompanied by the formation of a white solid. With propylene and the butenes H abstraction from the allyl position is predicted to be competitive with addition to the double bond. (auth)

32605 PROTONATION REACTIONS AT CARBON SITES IN THE ANION RADICALS OF CERTAIN UNSATURATED COMPOUNDS AND AROMATIC AMINO ACIDS. Van Paemel, C.; Frumin, H.; Brooks, V. L.; Failor, R.; Sevilla, M. D. (Oakland Univ., Rochester, MI). J. Phys. Chem.; 79: No. 8, 839-845 (10 Apr 1975).

The protonation reactions at carbon sites of the anion radicals of certain unsaturated compounds as well as aromatic amino acids and their analogs have been investigated in alkaline and neutral aqueous glasses by electron spin resonance spectroscopy. For the compounds acrylic acid, 3,3-dimethylacrylic acid, crotonic acid, acrylamide, and acrylonitrile protonation or deuteration is found to occur β to the electronegative group (R_3) to form an α-carbon radical: $R_1R_2C{=}CHR_3^{-} + H_2O \rightarrow R_1R_2CH{-}\dot{C}HR_3 + OH^{-}$. The anions were found to be stabilized when R_1 (or R_2) was a carboxyl (fumaric) or methyl (crotonic and 3,3-dimethylacrylic acid) group. The anions of acetylenedicarboxylic acid and hydrogen cyanide were also found to protonate in these aqueous glasses. The anions of four aromatic acids were found to protonate at carbon sites on the aromatic ring. Analogs of these amino acids which contain the aromatic ring were found to protonate at positions equivalent to those found in the amino acids. Molecular orbital calculations of the spin density and free valency show that the magnitude of these parameters can be correlated with the site of protonation and perhaps the tendency to protonate. (auth)

32606 ESR STUDY ON TRANSIENT RADICALS IN PLASTIC CRYSTALS UNDER ELECTRON IRRADIATION. Shiraishi, H.; Kadoi, H.; Hasegawa, K.; Tabata, Y.; Oshima, K. (Tokyo Univ. (Japan). Faculty of Engineering). Bull. Chem. Soc. Jap.; 47: No. 6, 1400-1403(Jun 1974).

An apparatus was constructed for ESR measurements during electron irradiation, and the behavior of transient radicals in the plastic crystals of cyclohexane (CyH) and 2,2,3,3-tetramethylbutane (TMB) was investigated. It was found from the experiment that cyclohexyl radical produced by irradiation of CyH decays with a rate constant of 2×10^{-8} exp(−7.9 kcal/RT)cm^3/s. The rate constant is in good agreement with the results reported by Buben et al. On the other hand, radicals formed in irradiated TMB were assigned to be $CH_3-\dot{C}(CH_3)_2$, $CH-\dot{C}(CH_3)-C(CH_3)_2-\dot{C}H_2$, and $CH_3-C(CH_3)_2-C(CH_3)_2-CH_2\cdot$ from the present results. Results indicate that the assignment made by Marx et al. should be corrected to some extent. In the plastic crystals of CyH and TMB, it was suggested that the decay reactions of the observed radicals are controlled by the diffusional migration of the radicals. The analysis of radiolytic products of TMB was also made, and the results were compared with the results of ESR observation. (auth)

32607 THE STRUCTURE AND REACTIVITY OF ORGANIC IONS IN GAS-PHASE RADIOLYSIS. VIII. The $C_7H_7^{+}$ Ion from Toluene and Ethylbenzene. Sagi, N.; Yamamoto, Y.; Nagaoka, K.; Takamuku, S.; Sakurai, H. (Osaka Univ., Suita (Japan). Inst. of Scientific and Industrial Research). Bull. Chem. Soc. Jap.; 47: No. 6, 1387-1392(Jun 1974).

The gas-phase radiolysis of a mixture of toluene or ethylbenzene and dimethylamine was studied at room temperature as a function of the dimethylamine pressure in order to investigate the structure and reactivity of the $C_7H_7^{+}$ ion which takes part in the subsequent ion-molecule reaction was suggested to be the benzyl type on the basis of the reaction products. The radiolyses of toluene-α-d_3 and ethylbenzene-α-d_2 in the presence and in the absence of dimethylamine were investigated. It was found that the $C_7H_7^{+}$ ion formed from toluene and ethylbenzene mainly consists of the benzyl ion, retaining its original structure. Two types of scrambling processes may be involved in the $C_7H_7^{+}$ ion formation, one of which, especially important in the case of toluene, includes the ring expansion of the original molecular ion, while the other consists of repeated rapid isomerization between the benzyl ion and the tropylium ion. These results were compared with those of mass spectrometric studies, which indicate that an almost complete isotope scrambling occurs, hence supporting the symmetrical tropylium structure for the $C_7H_7^{+}$ ion. (auth)

32608 CHEMICAL BEHAVIOR OF INTERMEDIATES PRODUCED IN SULFURIC ACID GLASS BY GAMMA IRRADIATION. II. Yield of Trapped Hydrogen Atoms in the System Containing Metallic Ions. Sasaki, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Bull. Chem. Soc. Jap.; 47: No. 6, 1319-1322(Jun 1974).

The yield of trapped hydrogen atoms, H_t, in gamma-irradiated sulfuric acid glass is remarkably increased by adding a small amount, 10^{-2}M, of metallic ions. The increase is followed with a slow decrease at the higher solute concentrations. The efficiency of the formation depends on the kind of cationic solute. The largest $G(H_t)$ is observed in a system containing Co^{2+} ions; it amounts to 8.7. These findings can be explained by a mechanism in which not only mobile electrons produced by the initial ionic processes, but also excited states of the matrix molecule, contribute to the H_t formation. The excitation energy is transferred from the matrix molecule to the solute, which consequently undergoes ionization; the resulting electron causes the H_t formation. This mechanism seems to be supported by the observation that the yield of H_t increases with a decrease in the charge-transfer energy of the solute in the rigid matrix. (auth)

32609 RADIATION HARDENING OF UNSATURATED POLYESTER COATINGS. Kagitani, T.; Mitsui, H.; Tsuneda, K.; Hosoi, F. (to Japan Atomic Energy Research Inst., Tokyo). Japanese Patent 1973-22821/B/. 17 Feb 1969. 3p. (In Japanese).

An unsaturated polyester coating material is crosslinked by ionizing radiations in the presence of acetylene. The coating material is in the form of a liquid and contains a polyester having unsaturated double and/or triple bonds in the molecule as well as a radiation polymerizable monomer. It is prepared by dissolving said unsaturated polyester resin with pigments in a solvent such as styrene, methylacrylate, and the like, preferably the radiation polymerizable liquid monomer. The preferred dose of radiation is 1×10^3 to 1×10^5. Heating or cooling is not required generally. The hardening can be promoted with a catalyst at an elevated temperature. The hardening step can be shortened as compared with conventional methods. In examples, the insoluble matter in boiled xylene is 85.1% when air is substituted by acetylene, whereas there is no insoluble matter in xylene at room temperature when it is not substituted. (JA)

32610 METHOD FOR FORMING A COATING LAYER. Suetsugu, M.; Kimura, T.; Kobayashi, J.; Matsushima, K.; Nakamoto, H. (to Mitsubishi Rayon Co. Ltd., Tokyo (Japan)). Japanese Patent 1973-20606/B/. 18 May 1970. 9p. (In Japanese).

A method for forming a coating layer comprises the steps of first treating the surface of an object with an organic compound containing at least 1% by weight of isocyanates, applying thereto a coating material substantially containing a compound having 0.5 to 12 polymerizable unsaturated radicals per 1,000 units of the molecules, and irradiating the applied coating material with high energy radiation. Adhesiveness between metals and coating layer, corrosion resistance, and after-working performance are improved. The isocyanates may be, alone or in combination with one another, aliphatic and aromatic mono-isocyanates, diisocyanates represented by OCN-R-NCO wherein R is an alkyl or cyclohexyl group having 2 to 23 carbon atoms, aromatic diisocyanates, and free isocyanate radicals. The desirable thickness of the coating layer would be 0.01 to 5μ, and the desirable temperature of drying would be 50°C to 300°C. The coating material to be crosslinked by irradiation may be unsaturated polyesters and/or vinyl monomers, compositions wherein the principal monomer thereof has polymerizable unsaturated radicals on its side chain, saturated or unsaturated polyesters or polyamides

having polymerizable radicals at their end, and vinyl monomers. The high energy radiation is preferably an electron beam at an energy level of 0.1 to 2 MeV, at a dose rate of 0.1 to 20 Mrad/sec and with a dose of 0.1 to 10 Mrad. Ultraviolet and visible light (3,000 to 8,000 Å) can be used in the presence of photo-polymerization catalysts such as benzoin and anthraquinone. (JA)

32611 METHOD OF COLOUR COATING STEEL PLATES. Masuda, H.; Iijima, K. (to Nippon Oils and Fats Co. Ltd., Tokyo). Japanese Patent 1973-7255/B/. 18 Dec 1967. 2p. (In Japanese).

A color coating material containing one or more kinds of acrylic compounds, prepolymers if necessary and pigments suspended therein, is rapidly hardened by irradiating with electron beams. The coating material may be rapidly hardened without removing the solvent and backing the paint coated object. The acrylic compounds may be acrylic acid, ethyl acrylate, buthyl acrylate, polyethylene glycol methacrylate, 2-hydroxy ethyl methacrylate and the like. The prepolymers may be acrylic or methacrylic esters of di-epoxide compounds such as bisphenol type, ether-ester type, novolac type, or etherified compounds of melamine reacted with acrylic or methacrylic glycol monoester, urethane bond compounds containing a hydroxy group such as polyester or polyethers with glycol monoesters of acrylic acid or methacrylic acid, and reaction products of glycol monoesters with saturated or unsaturated polyesters or compounds containing conjugated double bonds reacted with maleic anhydride. In one of the examples, a suspension which consists of 45 parts of butyl acrylate, 20 parts of 2-hydro ethyl methyl acrylate, 5 parts of acrylic acid and 30 parts of rutil is irradiated with a dose of 30 Mrad, resulting in a pencil hardness of 2H. (JA)

32612 THE RADIOLYTIC-CHAIN DECHLORINATION OF POLYCHLORINATED BIPHENYLS IN ALKALINE 2-PROPANOL SOLUTIONS. Sawai, T.; Shimokawa, T.; Shinozaki, Y. (Tokyo Metropolitan Isotope Research Center (Japan)). Bull. Chem. Soc. Jap.; 47: No. 8, 1889-1893(Aug 1974).

The radiolysis of solutions of polychlorinated biphenyls(PCB's) and potassium hydroxide in simple aliphatic alcohols was studied. The major products in alkaline 2-propanol solutions were potassium chloride, acetone, lower chlorinated biphenyls, and biphenyl. Their yields increased and the concentration of the hydroxide ions decreased with the dose. Acetone and potassium chloride were formed in high yields, and their concentrations were almost equal to the diminution in the hydroxide ions. The dechlorination yield was determined as a function of the dose, the dose rate, and the concentrations of PCB's, potassium hydroxide, and organic solutes. The chain-dechlorination reaction proceeded in the alkaline 2-propanol solution, but not in alkaline methanol, ethanol, 1-propanol, and butanols. The 2-propoxide radical anion, which is formed by the electron transfer from the hydroxide ion to the 2-propanol radical, is the chain carrier for the dechlorination reaction of PCB's in alkaline 2-propanol solutions. The mechanism is discussed in detail. (auth)

32613 ELECTRONIC ABSORPTION SPECTRA OF ANION RADICALS OF DIPHENYL SULFONE AND DIBENZOTHIOPHENE-S, S-DIOXIDE. Ito, O.; Matsuda, M. (Tohoku Univ., Sendai (Japan). Chemical Research Inst. of Non-Aqueous Solutions). Chem. Lett. (Tokyo); No. 8, 909-912(Aug 1974).

The anion radicals of diphenyl sulfone and dibenzothiophene-S, S-dioxide produced by γ-irradiation showed intense absorption bands at 1030 nm and 850 nm, respectively. These absorption bands were assigned to the charge resonance bands from the energy diagrams including d-orbitals on sulfone groups, and the delocalization of an added electron on both phenyl rings was confirmed. (auth)

32614 STRUCTURE AND REACTIVITY OF ORGANIC IONS IN GAS-PHASE RADIOLYSIS. VII. Proton Exchange Reaction in Electrophilic Aromatic Substitution. Yamamoto, Y.; Takamuku, S.; Sakurai, H. (Osaka Univ., Suita (Japan). Inst. of Scientific and Industrial Research). Chem. Lett. (Tokyo); No. 8, 849-852 (Aug 1974).

In the gas-phase radiolysis of a C_3H_8(100 mm)-C_6H_6(5 mm)-C_6D_6(5 mm) mixture, it has been shown that isopropylbenzene (IPB) formed by the attack of i-$C_3H_7^+$ ions to benzene consists of IPB-d_1, -d_2, -d_3, and -d_4 as well as IPB-d_0 and -d_5, indicating that a proton exchange between an intermediate complex and benzene molecules has occurred. (auth)

32615 RADIATION COPOLYMERIZATION OF VINYLIDENE FLUORIDE WITH FLUORIDE ANHYDRIDE OF PERFLUORO-METACRYLIC ACID. Usmanov, Kh. U.; Yul'chibaev, A. A.; Mukhamadaliev, N.; Yusupbekova, F. Z. (Tashkent State Univ.). Dokl. Akad. Nauk Uzb. SSR; No. 9, 47-48(1974). (In Russian).

The effect of dose rate and total dose on the copolymerization yield was studied using ^{60}Co γ-rays. It was established that with increase of the dose rate and total dose the copolymer yield was increased. The composition of the original monomer mixture also affected the yield with an increase of the fluoride anhydride causing a decrease in the yield. The solubility of the copolymer in various organic solvents and its resistance to nitric and sulfuric acids were determined. It is also characterized by high thermal stability and good adhesion to metals. (JSR)

32616 EFFECT OF POLAR GROUPS ON THE POST-IRRADIATION CONDUCTIVITY OF POLYSTYRENE. Parkinson, W. W.; Kelly, M. J. (Oak Ridge National Lab., TN). pp 29-45 of Recent Advances in Science and Technology of Materials. Vol. II. Bishay, A. (ed.). New York; Plenum Publishing Corp. (1974).

The resistivity of insulating materials for electrostatic, ion chamber dosimeters must be very high and must remain so after exposure to ionizing radiation. Low dielectric polarization and good fabrication characteristics make hydrocarbon polymers most suitable, but both the conductivity during irradiation and its decay afterward vary greatly even for the same type of polymer, probably depending on impurities. Amorphous, styrene-based polymers and copolymers polymerized in aqueous emulsion and initiated with $K_2S_2O_8$ were found to have much more rapid decay of conductivity after irradiation than pure polystyrene or other non-polar polymers. The synthesis method incorporates sulfate groups on the polymer chain ends and leaves emulsifier residues distributed throughout the polymer as was demonstrated by various analytical procedures. The behavior of the conduction current upon reversal of the applied potential and during repeated irradiation and measurement indicated that conduction was by electrons or positive holes and not by ions, except in specimens in which the ionic impurity and moisture content were excessive. Furthermore, the activation energy as well as the decay time of post-irradiation conductivity were smaller in the emulsion polystyrenes than in pure polymers. This relation conforms to trap-controlled conduction in semi-conductors assuming traps in a uniform distribution with respect to energy levels for the emulsion polymers and an exponential distribution in pure polystyrene. To identify the trapping species a synthesis program was carried out varying selected ingredients in the polymerization recipe. It was found that the post-irradiation conductivity was not dependent on the chemical nature of the emulsifier residues. On the other hand, the decay time of conductivity after irradiation did depend on the polar groups incorporated in the polymer chain. In contrast, mass-polymerization of maleic anhydride and methacrylic acid copolymers with styrene demonstrated that polar groups alone did not constitute effective traps. The incorporation of aqueous emulsifier in these copolymers resulted in short decay times of post-irradiation conductivity. It was concluded that effective charge carrier traps were constituted of a polar second phase highly dispersed through the polymer by association with polar groups incorporated on the polymer chain. (auth)

32617 FREE RADICALS IN LYSOZYME REACTED WITH PEROXIDIZING METHYL LINOLEATE. Schaich, K. M.; Karel, M. (Massachusetts Inst. of Tech., Cambridge). J. Food Sci.; 40: No. 3, 456-459(1975).

A methyl linoleate and lysozyme system was used to determine: (a) whether protein radicals can actually be detected with the technique of electron spin resonance spectroscopy; (b) how these radicals compare with those produced by gamma radiation; (c) what conditions are necessary for radical formation in lipid-protein systems, and (d) what specific effects water has on protein radical formation. (LK)

Radiochemistry and Nuclear Chemistry

32618 (JAERI-M-5567, pp 312-323) THE CHEMISTRY OF HEAVY AND SUPERHEAVY ELEMENTS. Ueno, K. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Developments in the field of actinide and transactinide elements are reviewed, including the discovery, preparation, purification, and chemical properties. Transuranium elements are produced from uranium by neutron irradiation or by heavy ion bombardment. Elements of atomic number up to 100 are obtained by successive build-up in a nuclear reactor, in which neutron absorption and beta decay occur alternately. In the neutron shower of a nuclear explosion, the heavier isotopes of the initial nuclide are formed by simultaneous absorption of several neutrons, which are then followed by the beta decays to give the elements of higher atomic numbers.

Still heavier nuclides are produced by heavy ion bombardment with an accelerator. The precipitation processes based on coprecipitation or adsorption, as well as paper chromatography and electrophoresis, are normally used as analytical methods. Extraction chromatography is suitable for the analytical separation of transplutonium elements and also for the purification and isolation of their milligram quantities. A double recoil method is generally used for the separation of short-lived heavy nuclides. Solvent extraction and ion exchange are the techniques most widely used for the separation of long-lived transuranium elements. Electronic configuration, oxidation states, properties of the metals and oxides, and chemical properties in the solution are also explained. The most conspicuous difference between the lanthanide and the actinide elements is the greater variety of stable oxidation states of the latter. Finally, research and development on the transuranium elements in JAERI are described. (auth)

32619 ANORGANISCHE TECHNOLOGIE. T. 2. (Inorganic Technology. P. 2). Winnacker, K.; Kuechler, L. (Eds.). Chemische Technologie. Muenchen, F. R. Germany; Hanser (1970). 694p. (In German).

The book deals with properties and production methods of glass, ceramics, rare earths, and inorganic sulfur, chromium and manganese compounds. Radio- and radiation-chemical problems in nuclear engineering are also discussed. (GE)

Hot-Atom Chemistry

Refer also to abstract 32580.

32620 ISOTOPE EFFECT OF ^{80}Br AND ^{82}Br PRODUCED BY NUCLEAR ISOMER TRANSITION. On Ion Cluster, (1). Yagi, M.; Kondo, K. (Tohoku Univ., Sendai (Japan). Lab. of Nuclear Science). Kakuriken Kenkyu Hokoku; 6: No. 2, 299-307(Dec 1973). (In Japanese).

The effect of additives having different dipole moments and temperature effects were studied on the systems of $H^{80m}Br-CH_4$ and $H^{82m}Br-CH_4$, using H*Br as the source molecule. H*Br is the most appropriate for the study on the isotope effect owing to thermal ionic reaction. In addition, some experience is reported on the comparison experiment between extraction method and potassium ferrocyanide method for determining yield. $H^{80m}Br$ and $H^{82m}Br$ were prepared by conventional methods. $CH_3{}^{82}Br$ and $CH_2{}^{82}BrBr$ were prepared by the removal of byproducts HBr and Br_2 from CH_3Br and CH_2Br_2 irradiated with thermal neutrons through $K_4Fe(CN)_6$ column, and subsequent fractional distillation. The pressure in a reaction vessel was 660 mm Hg generally, but it was 330 mm Hg in studies of the temperature effect on organic yield. The experimental temperature was –78, –22.9, –20, 0, 30, and 70°C. Radioactivity was measured with Ge(Li) semiconductor detector. The organic yield and CH_2Br_2/CH_3Br ratio determined by both methods coincided with each other on the system $H^{80m}Br-CH_4$ ($HBr/CH_4 = 0.1$), but there was some dispersion of result in the system Br_2-CH_4, using $CH_3{}^{82}Br$ and $CH_4{}^{82}BrBr$ as tracers. Additives having no dipole moment showed approximately same organic yield and yield distribution of $CH_3{}^{80}Br$ and $CH_2{}^{80}BrBr$, whereas additives having dipole moments, such as H_2S and SO_2, gave variation. The remarkable change of CH_2Br_2/CH_3Br value in the temperature range from –20 to 30°C, as the effect of temperature on yield distribution, suggests the existence of ion clusters. (JA)

32621 COMPARATIVE STUDIES OF IODIDE FORMATION IN SOLID BUTANE IRRADIATED WITH I^+ AND I_2^+ IONS. Cailleret, J.; Abbe, J. C.; Paulus, J. M. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires; Strasbourg Univ., 67 (France). Lab. de Chimie Nucleaire). Radiochim. Acta; 20: No. 1/2, 33-38(1974). (In French).

Previous experiments performed with a chemical accelerator in order to study the reactivity of I^+ ions with solid butane in the energy range between 5 and 3,000 eV were extended to I_2^+. The total organic yields and the relative yields of the iodides formed by both types of ions are identical for energies higher than 75 eV but large discrepancies appear for lower values. The mechanisms at the origin of the iodides are attributed to two steps reactions, the ions, radicals or excited species produced in the first step through kinetic energy transfer or charge transfer reactions reacting in the second step with the halogen. (auth)

32622 THE REACTION OF HOT DEUTERIUM ATOMS WITH CIS-2-BUTENE. Sato, S.; Nishida, S.; Hosoya, K. (Tokyo Inst. of Tech. (Japan). Faculty of Science). Bull. Chem. Soc. Jap.; 47: No. 8, 1880-1882(Aug 1974).

The photolysis of deuterium iodide at the wavelength of 2288 Å was carried out in the presence of cis-2-butene and iodine at 40°C. Among the products, hydrogen (D_2 and HD), methane (CH_3D), propylene ($CH_3CH = CHD$), n-butane ($CH_3CHDCHDCH_3$), and 1-butene were measured as a function of the pressure of cis-2-butene. The formation of HD at higher pressures of cis-2-butene was attributed to the abstruction of H atoms from cis-2-butene by hot D atoms. This reaction accounted for 8% of the total D atom reaction. The formations of CH_3D, C_3H_5D and $C_4H_5D_3$ were well explained by the successive reactions of hot butyl radicals, $C_4H_8D^*$. (auth)

32623 ESR STUDY OF HOT IONS, Ir(II) AND Ir(IV) IN GAMMA-IRRADIATED Ir(III) COMPLEXES. Fujiwara, S.; Watanabe, T.; Inoue, T. (Tokyo Univ. (Japan). Faculty of Science). Chem. Lett. (Tokyo); No. 7, 755-758(Jul 1974).

ESR study of Ir hot ions produced in γ-irradiated Ir(III) complexes was carried out. It was found that Ir(II) hot ions take d configuration of low spin state. The unpaired electron is localized in $d_{x^2-y^2}$ orbital in the elongated octahedral structure. Ir(IV) hot ions are found to be formed in irradiated Ir(III) hexachloro complexes. (auth)

32624 GAS PHASE REACTIONS OF SULFUR-38 AND SULFUR-35 ATOMS GENERATED BY NUCLEAR RECOIL. Kremer, L. N. III. Salt Lake City; Univ. of Utah (1974). 146p. University Microfilms Order No. 75-8699.

Thesis (Ph. D.).

Reactions of nuclear recoil generated sulfur atoms with H_2S, CH_4, H_2, and CS_2 were studied in the gas phase. The sulfur isotopes ^{38}S and ^{35}S used in these studies were produced via the $^{40}Ar(p,3p)^{38}S$, $^{34}S(n,\gamma)^{35}S$, and $^{35}Cl(n,p)^{35}S$ nuclear reactions. Radio gas chromatography was used to determine the gas phase product yields. In order to analyze COS, H_2S, and SO_2 as well as organic sulfur compounds a reversing flow gas chromatographic system was developed which separates all of these compounds in a single pass. The major findings of this dissertation is the importance of electronic states in the reactions of nuclear recoil sulfur. Pressure and concentration studies of the H_2S-Ar system indicate that the $S(^1D)$ reaction with H_2S leads to the formation of a vibrationally excited complex. Ground state, $S(^3P)$, reaction with H_2S is postulated to form HSSH which decomposes on the reaction vessel wall. Experiments with CH_4 suggest $S(^1D)$ insertion into the C–H bond to form CH_3SH and also support the interpretation of the Ar-H_2S experiments. Computer fitting of kinetic models to the data indicate that the rate constant for the $S(^1D)$ reaction with H_2S is comparable with the known rate constant of $S(^1D)$ reaction with CH_4. Studies of the sulfur atom reactions with H_2 can be interpreted either in terms of $S(^1D)$ insertion, or a hot primary reaction producing highly energetic HS radical intermediates. The CS_2 reaction data can also be explained as $S(^1D)$ reaction to form labeled CS_2 in the gas phase. (Diss. Abstr. Int., B)

Properties of Radioactive Materials

Refer also to abstract 33703.

32625 (AED-C-13-10(1974)) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. Section 13. Decontamination. Number 10. Philipp, H.; Wichmann, E. (comps.). (Zentralstelle fuer Atomkernenergie-Dokumentation, Leopoldshafen (F. R. Germany)). Dec 1974. 50p. (In Several Languages). Dep. NTIS (US Sales Only) $5.50.

A bibliography of all original literature available to the library division from August 1, 1973, to September 30, 1974, and abstracts from Informationen zur Kernforschung und Kerntechnik, International Nuclear Information System, Nuclear Science Abstracts, and Chemical Abstracts is compiled. The bibliography is divided into abstracts of comprehensive reviews, decontamination of installations and large surface areas, decontamination of materials and instruments, decontamination of persons and animals, decontamination of liquids, decontamination of gases, and miscellaneous (decontamination installations, means, and methods and cost analyses). An author, report, and patent index is appended. (JSR)

32626 (CONF-750112-3) SPECTROSCOPIC PROPERTIES OF Bk^{3+} AND Cf^{3+}. Carnall, W. T.; Fried, S. (Argonne National Lab., Ill. (USA)). [nd]. 32p. Dep. NTIS $4.75.

From symposium commemorating the 25th anniversary of the discovery of elements 97 and 98; Berkeley, USA (20 Jan 1975).

A brief historical review is given of the development of experimental studies on and theoretical interpretations of the spectroscopic properties of Bk^{3+} and Cf^{3+}. The topics discussed are solution spectra with macro quantities, energy level structures, crystal field interactions, crystal spectra-structure correlations, intensity relations, and calibration of transition probabilities. (JSR)

32627 (COO-2451-1) SYNTHESIS AND BIOLOGICAL INCORPORATION OF ICONS INTO MACROMOLECULES FOR NMR STUDY. Progress Report, June 1, 1974–May 31, 1975. Grant, D. M. (Utah Univ., Salt Lake City (USA)). 1975. Contract AT(11-1)-2451. 22p. Dep. NTIS $4.25.

The work plan calls for continued and expanded efforts to synthesize labeled organic molecules which can be incorporated into biological macromolecules for NMR studies. Biological incorporation will proceed by one or more of the following techniques: (1) use of mutant bacteria whose growth requires the labeled molecule; (2) suppression of biosynthesis in a bacterium of labeled molecule by its presence in excess; (3) production of antibodies in animals sensitized to a foreign hapten containing antigen and then the subsequent use of labeled haptens; and (4) addition of labeled coenzymes and substrates to an isolated enzymatic system. (auth)

32628 (JAERI-M-5567, pp 324-332) THE OXIDATION STATES OF THE HEAVY AND SUPERHEAVY ELEMENTS. Hara, M.; Sato, A.; Mitsugashira, T.; Kawasuji, I.; Suzuki, S. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

The observed oxidation states of the actinoid were discussed in comparison with those of the lanthanoid. The predicted oxidation states of the elements between Z = 104 to 172 were also discussed in connection with the extrapolated metal radii, the electron binding energies and ionization energies which had been deduced through the relativistic Hartree–Fock–Slater calculations. (auth)

32629 (LA-5883-PR, pp 123-147) ORGANIC AND BIOCHEMICAL SYNTHESIS. Feb 1975.

In biomedical and environmental research program of the LASL Health Division. Annual report, January–December 1974.

The research activities of the Organic and Biochemical Synthesis Group include: preparation of labeled compounds; biomedical applications of stable isotopes (clinical, pharmacological, and biochemical studies); biosynthesis and carbon-13 nuclear magnetic resonance characterization of labeled cells; carbon-13 nuclear magnetic resonance analysis of biosynthesized molecules (formation of lactate by glycolysis and photosynthetic incorporation of carbon dioxide into galactosylglycerol by red algae); and environmental, chemical, and other applications. (ERB)

32630 EFFECTS OF GAS ADDITIVES ON ISOMERIC TRANSITION ACTIVATED ^{82}Br REACTIONS WITH DIBROMOMETHANE. Rodriquez, J. M.; Lo, J. M.; Wai, C. M. (Univ. of Idaho, Moscow). Radiochem. Radioanal. Lett.; 20: No. 6, 353-361(20 Mar 1975).

Isomeric-transition activated ^{82}Br reactions with CH_2Br_2 in $I_2 + CH_2=CH_2$ scavenged gaseous system have been investigated. In addition to the expected substitution products $CH_2Br^{82}Br$ and $CHBr_2{}^{82}Br$, a major secondary product $CH_2=CHCH_2{}^{82}Br$ was found in this system. When gas additives with lower ionization potential than Br were added into the system, the yield of $CH_2=CHCH_2{}^{82}Br$ was greatly reduced suggesting that it was probably produced by ionic reactions. The possibility of forming $CH_2{}^{82}Br$ carbene from the excited substitution product $CH_2Br^{82}Br$ is also discussed. (auth)

32631 PREPARATION AND LATTICE PARAMETERS OF SOME AMERICIUM AND CURIUM PNICTIDES. Charvillat, J. P. (CEA, Fontenay Aux Roses, France); Benedict, U.; Damien, D.; Muller, W. Radiochem. Radioanal. Lett.; 20: No. 6, 371-381 (20 Mar 1975). (In French).

The preparation and x-ray characterization of some americium and curium pnictides are described. The previously unknown compounds AmP, CmP, CmSb, CmAs were found to exhibit the NaCl type of structure, and Am_4Sb_3 to crystallize in the body centered structure of anti-Th_3P_4 type. (auth)

32632 ISOTOPIC STUDY OF THE THERMAL DECOMPOSITION OF PEROXIDE COMPOUNDS OF URANIUM. Kuprii, V. Z.; Lunenok-Burmakina, V. A. (Kiev Technological Inst. of Light Industry). Zh. Neorg. Khim.; 20: No. 1, 270-272(Jan 1975). (In Russian).

By means of the isotopic method it was shown that the thermal decomposition of peroxide compounds of U proceeds with partial preservation of the peroxide bonds in the oxygen released. It was assumed that the peroxy group O_2^{2-} in these compounds is connected with the U by π bonds. (tr-auth)

32633 STRUCTURE AND THE STABILITY OF NEPTUNYLATE(V). Muenze, R. (Zentralinstitut fuer Kernforschung, Rossendorf). Isotopenpraxis; 11: No. 2, 68-69(Feb 1975). (In German).

The stability constant of pentavalent Np chelates was calculated using a simple electrostatic model of one-atom cations and ligands. The results obtained for mono- and bidentate ligands were higher than the measured values and the calculated stability constants for polydentate ligands was also too high. An evaluation of the causes for this disagreement led to the proposal of the structure of the neptunylate ion. (JSR)

32634 GAS PHASE XYLENE ISOMERIZATION. Perez, G. (CNR, Rome). Radiochem. Radioanal. Lett.; 20: No. 6, 383-390 (20 Mar 1975).

The reactions between the isomeric xylenes and two protonating agents, the HeT^+ and D_3^+ ions, were studied in gaseous phase. The results confirm that the substrate undergoes to isomerization by an intramolecular 1,2-methyl shift. The dependence of the reaction products on the experimental conditions and the energy of the ions is discussed briefly. The gas phase appears an interesting system to study isomerization and dealkylation processes. (auth)

32635 DERIVATOGRAPHIC INVESTIGATIONS ON THE THERMAL DEGRADATION OF PYRIDINE, ISOQUINOLINE, α,α-DIPYRIDYL AND O-PHENANTROLINE, RESP. BICHROMATE- OR CHROMATE-ION CONTAINING METAL COMPLEXES. II. Zinc(II)-, Cadmium(II)- and Manganese(II)-Complexes; III. Mercury(I and II)-, Uranyl-, Thorium-, Lanthanum- and Iron-Complexes. Lorant, B. (Institut fuer Lebensmittelkontrolle und Chemie der Hauptstadt Budapest (Hungary)). Thermochim. Acta; 9: No. 1, 67-75(May 1974). (In German).

Complexes were prepared of zinc(II), cadmium(II), manganese(II), mercury(I and II), uranium, thorium(IV), lanthanum, and iron ions with pyridine, isoquinoline, α,α-dipydiyl, or o-phenantroline ligands and bichromate or chromate ions. As is the case with Cu(II), Ni(II) and Co(II) complexes, the initial decomposition temperatures increased from the pyridine complexes to the phenantroline complexes. The lowest temperatures were about 100°C or even higher; the highest ones were above 200°C, but partly lower. The decompositions generally took place in two steps, but sometimes in one step only. Among the zinc complexes some were found in which base was present instead of water of hydration in the crystal lattice. The final products were the corresponding metal oxides, apart from chromium(III) oxide, or the corresponding chromates in the case of insufficient heating. With mercury complexes the oxides were removed completely. Some complexes decomposed explosively. The formulas were checked. Several complexes contained water of hydration. (INIS)

32636 MOESSBAUER SPECTROSCOPIC STUDIES OF THE EC-AFTER EFFECT IN ^{57}Co-LABELLED $[Co(NH_3)_6]$ $[Fe(CN)_6]$, $[Co(NH_3)_6]$ $[Cr(C_2O_4)_3]3H_2O$, AND $[Co(NH_3)_6]$ $[Fe(C_2O_4)_3]3H_2O$. Sano, H.; Ohnuma, T. (Tokyo Metropolitan Univ. (Japan). Faculty of Science). Chem. Lett. (Tokyo); No. , 589-592(Jun 1974).

It was demonstrated that oxalate ligands of trisoxalatochromate (III) and trisoxalatoferrate(III) complex anions located outside the first coordination sphere of the decayed atom are still involved in the local radiolytic processes initiated by EC-decay. The yields of ^{57}Fe species found in ferrous charge state were interpreted by using radiolytic data on potassium trisoxalatochromate(III) and trisoxalatoferrate(III). (auth)

32637 CHRONOPOTENTIOMETRIC STUDY OF THE REDUCTION OF TRIVALENT CURIUM IN MOLTEN (Li–K)Cl EUTECTIC. Martinot, L.; Reul, J.; Duyckaerts, G. (Univ., Liege). Anal. Lett.; 8: No. 4, 233-239(Apr 1975).

A chronopotentiometric study of the reduction $Cm(III) + 3e \rightarrow Cm(O)$ is reported. The diffusion coefficient increases from 3.6×10^{-6} cm^2 sec^{-1} to 17.2×10^{-6} cm^2 sec^{-1} in the temperature range 400 to 550°C. Diffusion data of various +1, +2, +3, and +4 ions are compared with regard to the charge density of the ions. (auth)

32638 U–Se AND U–Te SYSTEMS. Ellert, G. V.; Sevast'yanov, V. G.; Slovyanskikh, V. K. (Inst. of General and Inorganic Chemistry, Moscow). Zh. Neorg. Khim.; 20: No. 1, 221-227 (Jan 1975). (In Russian).

The results of the study of the U–Se and U–Te systems with 0 to 65 at. Se and Te in the high-temperature region were reported. The systems were studied by the methods of differential-thermal, chemical, and x-ray phase analyses. The microhardness of fused samples was measured. Phase diagrams were constructed from the data of the present data and from results obtained previously. (tr-auth)

32639 URANIUM (VI) AND URANIUM (IV): TWO SPECIAL TYPES OF HARD ACCEPTORS AND AN IMPLICATION OF THIS PROPERTY ON THEIR NATURE OF BONDING WITH DIFFERENT NUCLEOPHILES. Majumdar, A. K.; Bhattacharyya, R. G. (Jadavpur Univ., Calcutta (India). Dept. of Chemistry). J. Indian Chem. Soc.; 51: No. 1, 235-238(Jan 1974).

Studies on the complexes of uranium(VI) and uranium(IV) are reviewed with a view to understand the nature of their bonding

with different nucleophiles. Uranium behaves as a hard acceptor even in its higher oxidation state, because both UO_2^{2+} and U^{4+} ions are found not to form stable complexes with soft nucleophiles like R_3P, R_3A or A_2S. This physico-chemical characteristic is attributed to a large number vacancies both in d- and f- orbitals in valence shell of uranium making it a special type of electrophile. (INIS)

32640 SPECTRA, LIFETIMES AND ENERGY TRANSFER FOR URANYL SPECIES IN SOLUTION. Pant, D. D.; Tripathi, H. B. (Deb Singh Bisht Government Coll., Nainital (India). Dept. of Physics). J. Lumin.; 8: No. 6, 492-501(Apr 1974).

The lifetimes for various uranyl species under varying conditions of solvents, pH, etc., were measured. A large variation in lifetimes from about 10 μs for hydrolytic $UO_2^{2+}(UO_2)_n$ species to about 900 μs for anion complexed $UO_2(NO_3)_2$ species was observed. The lifetime data are in agreement with the calculated values when care is taken to isolate the contribution to absorption due to the F series only. The samples, in which more than one species are present in emission, show energy transfer from the higher energy species to the one having lower energy of excitation. As a result of this the lifetime of the donor is decreased and that of the acceptor increased. The donor decay is found to be exponential. A rise time is also observed in acceptor emission. The energy transfer mechanism is found to be of the Stern-Volmer type transfer. (INIS)

32641 SYNTHESIS OF TRITIUM-LABELLED α-MSH USING DIBROMO-α-MSH AS AN INTERMEDIARY. Nikolics, K.; Teplan, I.; Medzihradszky, K. (Semmeweis Medizinische Univ., Budapest). pp 282-285 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German)

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

For the synthesis of α-MSH of high specific activity (20—40 Ci/mM), a new method of synthesis, is described, using an α-MSH analogue containing 3,5-dibromotyrosine in place of tyrosine. From this product, by catalytic hydrogenation with tritium gas followed by chromatographic purification, it was possible to prepare higher specific activity α-MSH showing biological activity identical with the natural hormones. Some problems of radiolysis of the labelled hormone are also discussed. (auth)

32642 PREPARATION OF READY-TO-USE TECHNETIUM-99m AND RADIOPHARMACEUTICALS LABELLED WITH IT. Angelberger, P. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Vienna). pp 457-460 of Radioactive Isotope in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German)

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

In order to reduce labor and cost for nuclear medicine involved in preparation of radionuclides and radiopharmaceuticals, a production process for ready-to-use $^{99m}TcO_4^-$-solutions of very high activity concentration was developed. By means of a new labelling method based on Sn(II) as reducing agent, which is released by anodic oxidation into these solutions, radiopharmaceuticals were prepared in ready-to-use form: ^{99m}Tc-labelled Sn-DTPA, Human Serum Albumin, HSA Microspheres, Sn-Phytate as in vivo micro-colloid, and Bleomycin as a tumor-specific radiopharmaceutical. (auth)

32643 PREPARATION OF LABELLED PROSTAGLANDINS BY BIOSYNTHESIS. Jecsai, G.; Koppany, Z.; Mucha, I. (MTA Izotop Intezete, Budapest). Izotoptechnika; 18: No. 1, 14-20(Jan 1975). (In Hungarian).

The history of PG biosynthesis and preparation of PGE_2-5, 6, 8, 11, 12, 14, 15-^{3}H/n/ and PGE_2-5, 6-^{3}H are discussed. (auth)

32644 STUDIES ON THE FORMATION OF COMPLEXES OF GLUTAMINE WITH Y(III), La(III), Ce(III), AND U(VI). Sekhon, B. S.; Chopra, S. L. (Punjab Agricultural Univ., Ludhiana, India). Indian J. Chem.; 12: No. 12, 1322(Dec 1974).

The formation of complexes of Y(III), La(III), Ce(III) and U(VI) has been studied using Bjerrum-Calvin pH titration technique. Stepwise stability constants at 35° and 45° (μ = 0·1M) are reported. For 1 : 1 chelates the order of stabilities is Y(III) > La(III) while that for 1 : 2 chelates is UO_2(II) > Ce(III). (auth)

32645 FLUORO COMPLEX SALTS OF THORIUM(IV) WITH METHYL- AND ETHYL-AMMONIUM FLUORIDES, PYRIDINIUM, SUBSTITUTED PYRIDINIUM, QUINOLINIUM, AND ANILINIUM FLUORIDES AND ETHYLENEDIAMMONIUM AND O-PHENYLENEDIAMMONIUM FLUORIDES. Rai, H. C.; Sahoo, B. (Indian Inst. of Tech., Kharagpur). Indian J. Chem.; 12: No. 12, 1302-1303(Dec 1974).

A number of fluoro complex salts of thorium(IV) of the types $(RH^+)(ThF_5^-)$ where RH^+ = methylammonium, ethylammonium, pyridinium, substituted pyridinium, quinolinium and anilinium ions, and $(RH_2^{2+})(ThF_6^{2-})$ where RH_2^{2+} = ethylene diammonium and o-phenylene diammonium ions have been synthesized. The complexes are non-hygroscopic, sparingly soluble in water, and can be stored for several days without decomposition. The IR spectra of these complexes show a strong and broad band in the region 400-350 cm^{-1} due to Th-F stretching vibration. A comparison of the spectral data of the organic ammonium fluoride-thorium(IV) fluoride salts with the IR data of the salts of the type $M_7^IM_6^{IV}F_{31}$ manifests an eight-coordinated array of fluorine atoms about thorium(IV). (auth)

32646 INFLUENCE OF SAMPLE SIZE ON NON-ISOTHERMAL KINETICS OF DEHYDRATION OF HYDRATED OXALATES OF Mg(II), Ca(II), AND Sr(II) AND DEHYDROXYLATION OF $Mg(OH)_2$ AND α-$UO_3.H_2O$. Phadnis, A. B.; Karkhanavala, M. D. (Bhabha Atomic Research Centre, Bombay). Indian J. Chem.; 12: No. 12, 1286-1288(Dec 1974).

The influence of sample size on the rate of solid state reaction is demonstrated by studying the TG curves of the dehydration of hydrated oxalates of Mg, Ca, Sr and dehydroxylation of $Mg(OH)_2$ AND α-$UO_3 \cdot H_2O$. Values of activation energy are reported and the influence of the crystal structure is discussed. (auth)

32647 POLAROGRAPHY OF URANYL-MANDELATE COMPLEXES. Lai, T. T.; Chou, T. C. (Cheng Kung Univ., Taiwan (China). Dept. of Chemical Engineering). Porarografii; 19: No. 1-2, 17-24(Jun 1973).

The uranyl ion in mandelic acid solution was investigated by polarography. The chelate species formed was found to be UO_2A^+ at pH 3.8. The diffusion coefficient of chelate decreases with increasing pH value and the square root of the ionic strength. When pH > 5.8, an irreversible and diffusion-controlled wave was obtained due to the hydroxylation of the chelate species. The kinetic parameters of the electrode reduction were found to be that k_s is in the order of 10^{-4} cm/sec and α is 0.32 ± 0.01. (auth)

32648 CONTINUOUS FLUID BED REACTOR FOR FISSIONABLE MATERIAL. Ziegler, D. L. (to United States Energy Research and Development Administration). US Patent 3,869,256. 4 Mar 1975. Filed date 28 Sep 1972. 8p.

Plutonium (Pu) purification and plutonium hexafluoride (PuF_6) formation are achieved on a continuous basis by feeding particulate material into one end of an elongated and horizontally disposed vessel having an upper section with generally converging side walls and a lower section with generally vertical side walls, compartmented throughout its length by transversely disposed baffles, so that particulate material flows through the vessel in vertical generally zigzag fashion, being fluidized by dispersing gas that enters the compartment from a lower narrow compartment and discharges through an upper widened compartment. Vaporous PuF_6 formed from a reaction between the dispersing gas and the particulate material discharges through the upper widened compartment and solid impurities discharge for collection through a port at a far or distal end of the elongated vessel. (Official Gazette)

Radioactive Waste Treatment

Refer also to abstracts 34095 and 34097.

32649 (ANL-8135) TRITIUM AND NOBLE-GAS FISSION PRODUCTS IN THE NUCLEAR FUEL CYCLE. II. Fuel Reprocessing Plants. Kullen, B. J.; Trevorrow, L. E.; Steindler, M. J. (Argonne National Lab., Ill. (USA)). Mar 1975. Contract W-31-109-Eng-38. 70p. Dep. NTIS $5.45.

The behavior of tritium and noble gas fission products in fuel reprocessing operations is described. Estimates of the amounts of tritium and noble gases in present-day commercial fuel-reprocessing plants, as well as their pathways in the processing steps, are presented. The effects of possible future head-end modifications and waste management techniques on the appearance of these fission products in various waste streams are estimated. Brief descriptions of AEC-operated reprocessing facilities and foreign reprocessing plants and tables of pertinent properties of tritium and noble gases are included in appendix form. (auth)

32650 (MLM-2081(LD)) TRITIUM EFFLUENT CONTROL PROJECT. Progress Report: April–June 1973. Kershner, C. J. (Mound Lab., Miamisburg, Ohio (USA)). Kershner, C. J. (Mound Lab., Miamisburg, Ohio (USA)). 15 Aug 1973. Contract AT-33-1-GEN-53. 41p. Dep. NTIS $5.25.

The objective of the Tritium Effluent Control Project is to develop both technology and equipment to the point where the tritium

concentration is Mound's effluents can be reduced to 10% of the present RCG levels and total emissions can be reduced to an as-low-as-practicable level. A "prevent dilution" and recovery approach is being taken. Cryogenic adsorption of active gases is being studied as a means of tritium decontamination and purification for helium glovebox atmospheres. (auth)

32651 (MLM-2100(LD)) TRITIUM EFFLUENT CONTROL PROJECT. Project Report: July–September 1973. Kershner, C. J. (Mound Lab., Miamisburg, Ohio (USA)). 26 Nov 1973. Contract AT-33-1-GEN-53. 28p. Dep. NTIS $4.50.

To control and limit tritium effluent levels to less than 10% of the Radioactivity Concentration Guide, a "prevent dilution" and recovery approach is being taken. Recovery of trace levels of tritium from recirculating streams of helium containment atmospheres in glovebox systems is one aspect of this approach. Fixed bed cryogenic adsorption coupled with cryogenic distillation is being studied for tritium recovery. Experimental single component adsorption isotherm measurements were completed for oxygen on a coconut charcoal at 77.2°K. In the cryogenic adsorbate separation study, a new adsorption trap with low dead volume was fabricated and a gas chromatographic system was assembled for sampling the desorption stream. Mound Laboratory engineering and outside contractor efforts were coordinated toward installation of a 1000-scfm prototype Emergency Containment System. (LK)

32652 (MLM-2129(LD)) TRITIUM EFFLUENT CONTROL PROJECT. Progress Report: October–December 1973. Kershner, C. J. (Mound Lab., Miamisburg, Ohio (USA)). 15 Mar 1974. Contract AT-33-1-GEN-53. 16p. Dep. NTIS $4.00.

In the glovebox atmosphere decontamination by cryogenic adsorption study, adsorption isotherms were measured at 77°K for hydrogen on Linde type 4A and Linde type 5A molecular sieves. Design and fabrication of the experimental apparatus for the dynamic chromatographic separation studies was completed. The hydrogen isotope distillation system was modified to increase the boiler power that could be sustained without flooding the column. In the tritiated liquid waste decontamination study, the General Electric regenerative cell was operated successfully in the fuel cell mode to produce a reduction of deuterium (stand-in for tritium) in a H_2–D_2 feed gas mixture. (LK)

32653 (MLM-2146(LD)) TRITIUM EFFLUENT CONTROL PROJECT. Progress Report: January–March 1974. Kershner, C. J. (Mound Lab., Miamisburg, Ohio (USA)). 3 Jul 1974. Contract AT-33-1-GEN-53. 28p. Dep. NTIS $4.50.

Cryogenic adsorption of active gases is being studied as a means of tritium decontamination and purification for helium glovebox atmospheres. Excellent separations and hydrogen yields were obtained with feed gas mixtures of from 50 to 2.2% hydrogen in nitrogen using an activated charcoal column in a chromatographic mode at liquid nitrogen temperature. Progress is reported in the tritiated liquid waste decontamination and hydrogen isotope distillation work. (LK)

32654 (PNCT-841-74-14) BITUMINIZATION OF RADIOACTIVE WASTES TESTS WITH A BENCH-SCALE PILOT PLANT. Segawa, T.; Hoshino, T.; Miyao, H.; Muto, H.; Yamamoto, M. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). 11 Jun 1974. 48p. (In Japanese). INIS.

To bituminize the evaporator concentrates of intermediate-level radioactive liquid wastes and the chemical sludges of low-level wastes from PNC reprocessing plant under construction, development work has been carried out with a bench-scale consisting of the thin film evaporator of 0.1 M^2 heated surface (100 mm diam., 300 mm long) since 1972. This is equipped with a circulation system of heat transfer medium oil to a maximum temperature of 250°C. Since main constituent of the evaporator concentrates is sodium nitrate, the temperature of heating medium oil is limited to 200°C to avoid the oxidation-reduction reaction between bitumen and sodium nitrate. This reaction will be detected on lowering pH of the condensates. Distribution of radioisotope for distillates and off-gas streams was examined using the simulated evaporator concentrates containing radioisotopes (^{85}Sr, ^{103}Ru, ^{141}Ce). The decontamination factors for ^{85}Sr, ^{103}Ru, and ^{141}Ce are 3.1×10^3, 1.8×10^4, 9.4×10^4 for the distillates and 6×10^4, 1×10^5, 1.1×10^5 for the off-gas streams, respectively. It was found that trichloroethylene used for decontamination of the equipment could be recovered by distillation and reused. (auth)

32655 VOLUME EVALUATION OF SOLIDIFIED RADIOACTIVE WASTES WITH CEMENT. Tsutsui, T.; Nishimaki, K. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Hoken Butsuri; 9: No. 2, 87-94(Jun 1974). (In Japanese).

For land storage of solidified radioactive wastes with cement, their volume must be minimized with keeping a sufficient strength. Generally, the material strength and the volume of a solidified waste are dependent on the composition of mixed waste, cement and water. However, their relationships have not yet been investigated. In this report, Volume Factor (V.F.) was defined as the volumetric increase of solidified waste, and the value of V.F. and the strength were determined experimentally for the various compositions of radioactive wastes, cement and water. The experimental results were illustrated graphically for the handy use of practical estimations of V.F. and the strength of solidified radioactive wastes with cement. (auth)

32656 DECONTAMINATION PROCEDURE FOR RADIOACTIVE LIQUIDS. Peeters, K.; van de Voorde, N. (to Societe Belge pour l'Industrie Nucleaire, Brussels). German(FRG) Patent 2,242,412/A/. 7 Mar 1974. 6p. (In German).

The patented method deals with the adsorption or chemisorption of radioactive ions, especially in trace amounts, coming from contaminated liquids on prepared precipitates. The adsorbent is a mixture of at least two of the following three salts: a barium salt, a metal sulfide, and a metal ferrocyanide. A salt mixture of copper ferrocyanide and barium carbonate proves to be particularly effective and at the same time economical, being able to adsorb a high percentage (approximately 95 to 99.6%) of radioactive Cs, Sr, Co, Ru, and Sb. (GE)

32657 METHOD FOR THE CONCENTRATION AND DENITRATION OF RADIOACTIVE SOLUTIONS CONTAINING NITRIC ACID. Krug, G.; Lahr, H.; Vornhusen, H. (to Gelsenberg A. G., Essen (F.R. Germany)). German(FRG) Patent 2,240,925/S/. 28 Feb 1974. 11p. (In German).

A method, especially suitable for thorium-containing solutions, of concentrating and denitrating radioactive solutions is described. By the addition of phosphoric acid and formaldehyde as reducing agent to the solution to be evaporated, the nitrate content is reduced to less than 0.001 Mol/l where only very weakly radioactive condensation products are obtained. The process can be carried out continuously as well as discontinuously. (GE)

32658 METHOD FOR THE VITRIFICATION OF RADIOACTIVE WASTES INTO PHOSPHATE GLASSES. Krug, G.; Lahr, H.; Vornhusen, H. (to Gelsenberg A. G., Essen (F.R. Germany)). German(FRG) Patent 2,240,928/S/. 14 Mar 1974. 9p. (In German).

A method is described where radioactive waste solutions, in particular thorium-containing or coming from the THOREX process, are concentrated denitrated, and finally melted in a phosphate glass. The gases obtained during vitrification are led into the liquid phase of the concentration stage. (GE)

32659 HIGH LEVEL WASTE MANAGEMENT: II. New Developments at Eurochemic. Geel, J. N. C. van (Eurochemic, Mol, Netherlands). Atoomenergie Haar Toepass.; 17: No. 2, 43-47(Feb 1975).

Most countries still store their high level wastes in liquid form. One of the explanations for this situation is that the solidification processes and their products, calcines and vitreous products, still call for substantial improvements. Several recent developments include: fluid-bed calcination; the low temperature solidification (LOTES) process; the incorporation of granular solids into a metallic matrix; and the production of vitreous beads. (NL)

32660 HYDROGEN AND OXYGEN ISOTOPE RATIOS IN SILICA FROM THE JOIDES DEEP SEA DRILLING PROJECT. Knauth, L. P.; Epstein, S. (California Inst. of Tech., Pasadena (USA). Div. of Geological Sciences). Earth Planet. Sci. Lett.; 25: No. 1, 1-10(Feb 1975).

Water extracted from opal-CT ("porcellanite", "cristobalite"), granular microcrystalline quartz (chert), and pure fibrous quartz (chalcedony) in cherts from the JOIDES Deep Sea Drilling Project is 56‰ to 87‰ depleted in deuterium relative to the water in which the silica formed. This large fractionation is similar in magnitude and sign to that observed for hydroxyl in clay minerals and suggests that water extracted from these forms of silica has been derived from hydroxyl groups within the silica. $\delta^{18}O$-values for opal-CT at sites 61, 64, 70B and 149 vary from 34.3‰ to 37.2‰ and show no direct correlation with depth of burial. Granular microcrystalline quartz in these cores is 0.5‰ depleted in ^{18}O relative to coexisting opal-CT at sediment depths of 100 m and the depletion increases to 2‰ for sediments buried below 384 m. These relationships suggest that opal-CT forms before significant burial while granular microcrystalline quartz forms during deeper burial at warmer temperatures. The temperature at which opal-CT forms is thus probably approximately equal to the temperature of the overlying bottom water. Isotopic temperatures deduced for opal-CT formation are preliminary and very approximate, but yield Eocene deep-water temperatures of 5 - 13°C, and 6°C for the upper Cretaceous sample. Pure euhedral quartz crystals lining a cavity in opal-

CT at 388 m in core 8-70B-4cc have a $\delta^{18}O$ value of +29.8‰ and probably formed near maximum burial. The isotopic temperature is approximately 32°C. (auth)

32661 PRELIMINARY RESEARCH ON ISOLATION AND REMOVAL OF LONG-LIVED RADIONUCLIDES IN REACTOR COOLANT BY ION EXCHANGE RESIN. Takagi, S.; Koyama, H. (Central Research Inst. of Electric Power Industry, Komae, Tokyo (Japan). Technical Lab. No. 1). J. Nucl. Sci. Technol. (Tokyo); 11: No. 8, 326-333(Aug 1974).

The rate of accumulation of radioactive waste will rise with the increase of nuclear power generation. If the radioactive nuclides produced in nuclear power plants can be separated according to their half-lives, the measures for permanent disposal will be limited to the waste containing only the long-lived nuclides, and the volume of such waste will thereby be markedly reduced. The short-lived nuclides will decay away in a relatively short time, after which they will be disposed of without danger as nonradioactive waste. Duolite CS-100R, which is a cation exchange resin of weakly acid type, and, when impregnated with citrate or iminodiacetate ion, Amberlite IRA-402, an anion exchange resin of strongly basic type, both showed strong affinities with the short-lived ^{59}Fe (45.6 day) and ^{64}Cu (12.8 hr), while such long-lived nuclides as ^{90}Sr (27.7 yr) and ^{60}Co (5.3 yr) were found to be expelled from the resin by Fe and Cu. With Amberlite IRA-402, ground and sifted to 40 ~ 100 mesh and impregnated with citrate ion, through which the sample solution was passed at a specific space velocity of 25, about 90% of the Fe and about 80% of the Cu contained in the sample were absorbed in the resin, while all the long-lived radionuclides passed through. If this resin is loaded in a column installed upstream of the conventional demineralizers of a nuclear power station, most of the short-lived nuclides will be separated from the long-lived radioactivity requiring permanent disposal, thus markedly reducing the amounts of waste requiring handling as permanent waste. (auth)

32662 REMOVAL OF RADIOACTIVE CESIUM FROM LOW-ACTIVITY LIQUID WASTES BY NATURAL AND MODIFIED BENTONITES. Tashpulatov, Zh.; Aripov, E. A.; Sultanov, A. S.; Khosilbekov, Kh. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 8, 22-23(1974). (In Russian).

The purification of water containing small amounts of ^{137}Cs, using natural bentonite and bentonite with the addition of water-soluble polyelectrolyte K-4 was studied. The results showed that the adsorption of ^{137}Cs on bentonite containing K-4 was much greater than on the natural bentonite. (JSR)

Radioisotope Production

Refer also to abstracts 33361, 33614, 33687, 34889, and 34899.

32663 (JAERI-M-5567, pp 342-349) RADIOISOTOPE PRODUCTION BY HEAVY IONS. Yoshizawa, Y. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Recoil and on-line isotope separation techniques for isotope production from heavy ions are reviewed. (auth)

32664 (JAERI-M-5567, pp 360-364) PREPARATION OF RADIOISOTOPES BY HEAVY ION BOMBARDMENT AND THEIR USE. Tanaka, K. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

The technical problems concerning the preparation of radioisotopes for nuclear medicine by heavy ion bombardment and a possible method of characteristic use are discussed. (auth)

32665 IODINE VAPOR GENERATOR FOR CALIBRATING AN APPARATUS FOR MEASURING ^{131}I CONCENTRATION IN AIR. Krzesniak, J.; Jagielak, J.; Zak, A. (Centralne Lab. Ochrony Radiologicznej, Warsaw (Poland)); Zdrojewski, S. Z. (Wyzsza Szkola Inzynierska, Kielce (Poland)). Postepy Fiz. Med.; 8: 59-61(1973). (In Polish).

From 3rd symposium of Polish Medical Physics Society; Zabrze, Poland (10 May 1972).

A method was developed for obtaining crystalline ^{127}I sources labelled with ^{131}I, with the aid of a specially designed semi-automatic apparatus. Iodine vapor was generated by extracting it from radioiodide solutions, prepared with a remotely controlled pipetting device. The iodine generation receiver was placed in a thermostat. The iodine vapor from the receiver entrained by the nitrogen stream, after being mixed with a measured amount of air, was transferred onto carbon filters. Preliminary determinations were made of the effect of the velocity of the flow of the carrier gas and the temperature on the intensity of the iodine vapor generated. The results obtained were compared with the theoretical data. (auth)

32666 PREPARATION OF CARRIER-FREE RADIOACTIVE ALUMINUM. Alfassi, B.; Kushelevsky, A. P. (Univ. of the Negev, Beer Sheva, Israel). Radiochem. Radioanal. Lett.; 20: No. 6, 347-351(20 Mar 1975).

A simple method for producing and separating usable amounts of free ^{28}Al using a 14-MeV neutron generator is described. Some factors affecting the yield of the preparation were determined. (auth)

32667 DETERMINATION OF RADIOACTIVE IMPURITIES IN ^{99m}Tc ELUTANTS AND THEIR CONTRIBUTION TO THE TOTAL DOSE. Sorantin, H.; Strachotinsky, C.; Krejsa, P. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Seibersdorf). pp 19-30 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German)

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

The production of $^{99}Mo/Tc$ generators by separation of ^{99}Mo from fission product solutions or by neutron activation of Mo is briefly described. A discussion of the radioactive impurities follows. Gamma ray spectra show that in generators using fission Mo, only ^{103}Ru and ^{131}I are present. Otherwise in generators containing activated Mo ^{65}Zn, ^{92}Nb, ^{95}Nb, ^{124}Sb, and ^{134}Cs can be found. Using 0,9% sodium chloride solution, only radionuclides with short half-lives such as ^{103}Ru (39,5 d) and ^{131}I (8,05 d) are eluted from fission Mo generators. In the eluates of generators with activated Mo ^{134}Cs (2,1 a) is present. The activities of the different contaminants were determined, and the resulting doses in the critical organs were computed. (auth)

32668 PRESENT STATE OF ISOTOPE PRODUCTION IN EUROPE. Szirtes, L. (MTA Izotop Intezete, Budapest). Izoptechnika; 18: No. 1, 5-8(Jan 1975). (In Hungarian).

Accelerators and preparations of ^{99m}Tc kits for human diagnostics come into the limelight. Reconstruction and augmentation of production laboratories are discussed. (auth)

32669 USE OF ALUMINA AS ION EXCHANGER IN THE SEPARATION OF CARRIER-FREE ^{210}Bi FROM ^{210}Pb. Bhattacharyya, D. K. (Saha Inst. of Nuclear Physics, Calcutta). Separ. Sci.; 9: No. 3, 257-260(1974).

An equilibrium solution of these elements, as sulfates, at pH ≃ 1 was added to a steam-jacketted column of alumina, and the Pb was eluted with 0.5N-H_2SO_4 and H_2O. The ^{210}Bi (of high radiochemical purity) was then eluted with hot HNO_3. (Anal. Abstr.)

Reactor Fuel Reprocessing

Refer also to abstracts 32491, 34962, 35176, 35177, and 35182.

32670 (CEA-CONF-2726) SAFETY IN EXTRACTION OPERATIONS. Rouyer, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). 1974. 15p. (In French). INIS.

From French-Spanish colloquium; Marcoule; Fontenay-aux-Roses, France (25 Apr 1974).

The safety of extraction units in processing plants is related to the type bound up with the nature of fuel processed, the relative efficiency of the extractor used, and the production capacity of this element. The part played by the extractor and the production capacity is examined, and a method is proposed to estimate the safety of a continuous extraction process. The possibilities of fissile matter build-up under transient conditions were studied and examples given in the case of mixer-decanters. These studies involved calculations that were performed by a computer. Programs are now available for mixer-decanters and pulsed columns. (FR)

32671 (CEA-CONF-2736) LATEST INNOVATIONS IN EQUIPMENT (ROTARY DISSOLVER, PULSED FILTER, PULSED COLUMNS). Goumondy, J. P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). 1974. 9p. (In French). INIS.

From French-Spanish colloquium; Marcoule; Fontenay-aux-Roses, France (25 Apr 1974).

New equipment was designed and developed for the main operations involved in reprocessing, i.e., fuel dissolution, clarification of dissolution solutions, liquid-liquid extraction. For the dissolution stage a continuous rotary dissolver or "wheel dissolver" was designed, more flexible in use and with a higher processing capacity than the discontinuous dissolvers used at present. For

clarification of solutions, a continuous filtration process with periodic filter cleaning or "pulsed filter" was developed; this prevents rapid clogging of the filter elements and thus avoids the need for their frequent replacement while maintaining a very good filtration efficiency. Hydrodynamic research on the working of the pulsed columns led to certain technological improvements on this apparatus, which increase the specific yields and lead to more efficient transfer of matter and greater safety of operation. (FR)

32672 (CEA-CONF-2741) THE USE OF FORMIC ACID IN THE RE-EXTRACTION OF Pu. Germain, M.; Bathellier, A.; Berard, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). 1974. 15p. (In French). INIS.

From French-Spanish colloquium; Marcoule; Fontenay-aux-Roses, France (25 Apr 1974).

Formic acid is able to complex tetravalent plutonium in aqueous solution and to displace it partially from the organic phases used for its extraction. The efficiency of the plutonium re-extraction or partition operations carried out during nuclear fuel reprocessing can be considerably improved by addition of formic acid. The solutions obtained are more concentrated in plutonium and the formic acid they contain can easily be eliminated by simple boiling in the presence of nitric acid. Some examples of plutonium re-extraction and partition based on this process are given. (FR)

32673 DETERMINATION OF OPTIMAL PROCESS VARIABLES FOR TWO-CYCLE PUREX PROCESS. Katoh, N.; Kiyose, R.; Yamamoto, Y. (Tokyo Univ. (Japan). Faculty of Engineering). J. Nucl. Sci. Technol. (Tokyo); 11: No. 7, 293-299(Jul 1974).

The large and complicated system that is the Purex process is divided into units possessing common functions. Then, using the concentration profile determined by linear search, the inputs, the outputs, and the concentration profiles of all the individual units can be determined systematically. Using this approach, Powell's method and multilevel control theory is applied to the Purex process design problem, which is thereby reduced to a problem of optimization. Numerical calculations are carried out, resulting in optimal process variables well within the range of practicability. These process variables are calculated without taking into consideration such relevant but difficult factors as criticality and the instability of Pu solutions. These factors could, however be accounted for by adding appropriate penalty terms to the performance index. The computer program devised for the present calculations is given the code name POSER (Program for Optimization of Solvent Extraction Process). (auth)

32674 RADIOACTIVE RUTHENIUM IN NUCLEAR FUEL REPROCESSING. Hoshino, T. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works); Watari, K. Kagaku No Ryoiki; 28: No. 3, 211-218(Mar 1974). (In Japanese).

The Purex reprocessing process is explained as it is adopted in the reprocessing plant now under construction by the Power Reactor and Nuclear Fuel Development Corporation. The plant design was assigned to Saint-Gobain Techniques Nouvelles S. A. The plant capacity is 0.7 tU/d. The fuel to be reprocessed is sheathed in Zircaloy or stainless steel cladding. The degree of burnup is below 28,000 MWd/t. The specific output is below 35 MW/T. Cooling is for 180 days. Enrichment of uranium is below 4%. Products are purified UO_3 powder and purified $Pu(NO_3)_4$ solution. According to the nuclide composition of used fuel, there are 4.1×10^4 β Ci/t of $^{103}Ru-^{103}Rh$ and 7.1×10^4 β Ci/t of $^{106}Ru-^{106}Rh$. Several percent of the total ruthenium is radioactive ruthenium. In the first separation cycle, U and Pu are separated from FP, and are transferred to the second separation cycle. In the second separation cycle, U is separated from Pu with $U(NO_3)_4$ and hydrazine. Most ruthenium enters extraction waste or waste liquid of solvent cleaning, and finally is delivered to high level waste reprocessing step. Ruthenium nitrate complex extracted into TBP transfers to water phase in the step of solvent recovery, and is delivered to high level radioactive waste disposal step together with the extraction waste from the first cycle. In 1990, the amount of ruthenium disposal will reach approximately 13 times as much as the amount at present. (JA)

CONTROLLED THERMONUCLEAR RESEARCH

32675 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 8, No. 12, 1974. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumnetation (1974). 55p.

Plasma Confinement and Heating

Refer also to abstracts 32727 and 32742.

32676 (EUR-5064e, pp 145-189) PROBLEMS IN PLASMA PHYSICS. Eubank, H. P. (Princeton Univ., NJ). Nov 1974.

In international school of plasma physics, Varenna on Lake Como, Italy, September 27–October 9, 1971. Course on instabilities and confinement in toroidal plasmas.

The following topics are discussed: (1) neutral beam injection, (2) plasma heating by parametric instabilities, (3) review of far infrared laser technology and some plasma applications, (4) determination of plasma ion temperatures from fast neutral atom emission, and (5) plasma measurements with particle beams. (MOW)

32677 (EUR-5064e, pp 243-265) NEOCLASSICAL THEORY OF TRANSIT TIME MAGNETIC PUMPING (TTMP) IN TOROIDAL GEOMETRY. Canobbio, E. (CEN, Grenoble, France). Nov 1974.

In international school of plasma physics, Varenna on Lake Como, Italy, September 27–October 9, 1971. Course on instabilities and confinement in toroidal plasmas.

Some simple physical arguments are given for the basic mechanism of neoclassical power absorption by TTMP in the various parameter ranges. The theoretical model for the most general toroidal field configuration is defined by giving the rf field components and the equation of motion in the drift approximation. Power absorption in the intermediate-ν regime is derived by a linear calculation. An exact nonlinear calculation of power absorption at very small ν together with an evaluation of the critical collision frequency ν_c separating the two regimes is presented. The relation of TTMP heating to toroidal equilibrium is discussed. (MOW)

32678 (EUR-5064e, pp 267-319) SELECTED TOPICS IN RADIO FREQUENCY HEATING OF TOROIDAL PLASMAS. Hooke, W. (Princeton Univ., NJ). Nov 1974.

In international school of plasma physics, Varenna on Lake Como, Italy, September 27–October 9, 1971. Course on instabilities and confinement in toroidal plasmas.

The use of rf heating techniques for tokamak plasmas is discussed. The rf heating results on the Model C stellarator at Princeton are summarized. Some problems with rf heating of tokamaks are described. A general discussion of lower hybrid resonance heating is given. (MOW)

32679 (EUR-5064e, pp 321-333) PLASMA HEATING AT LOWER HYBRID FREQUENCY. Ichtchenko, G. (CEN, Grenoble, France). Nov 1974.

In international school of plasma physics, Varenna on Lake Como, Italy, September 27–October 9, 1971. Course on instabilities and confinement in toroidal plasmas.

In view of the application to the heating of a toroidal machine, the dispersion equation is solved for the electrostatic waves in a hot plasma in a thermodynamic equilibrium. The wave penetration, the coupling between electrostatic and electromagnetic modes, the limitation of the electric field due to turbulence effects, and the possibility of exciting the waves inside a liner of a machine are discussed. (auth)

32680 (EUR-CEA-FC-757) TRAPPING ROLE IN THE THEORY OF STRONG TURBULENCE IN PLASMAS. Rolland, P. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Grenoble, 38 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service d'Ionique Generale). Dec 1974. 38p. (In French). INIS.

The usual theories of strong plasma turbulence suppose that the perturbed trajectories suffer weak deviations from the unperturbed trajectories, and neglect the contribution of trapped orbits which suffer important deviations. This approximation is valid only if the correlation time of the field is much smaller than the trapping time. The need for a theory taking trapping into account has been shown. The role played by the particles which are trapped in the potential holes is examined and it is shown that in some range of velocities, the diffusion coefficient D (v) can be drastically modified. This modification depends on the statistical parameters of the field, which are here regarded as given. The self-consistent problem, which can be solved only for a given experimental situation, will be treated in a following work. (FR)

32681 (IPPJ–182) THEORY OF THE ADIABATIC RF PLUGGING IN THE MAGNETIC CUSP FIELD. Hatori, T.; Watanabe, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1974. 38p. INIS.

The necessary and sufficient condition is obtained for describing the guiding center motion of a particle by the quasi-potential. This analysis leads to a new concept of the "critical energy", the height of the adiabatic barrier, which is proportional to $E_0^{2/3}$, E_0 being the strength of the rf electric field in the plasma. The theoretical results are confirmed by numerical calculations. (auth)

32682 (IPPJ–187) TRAPPING OF CHARGED PARTICLES BY A TRAVELLING WAVE WITH INCREASING PHASE VELOCITY. Midzuno, Y. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1974. 19p. INIS.

The number of charged particles which are trapped by an accelerated wave in a plasma is calculated on the basis of a simple model. It is assumed that particles move adiabatically in travelling mirrors of the form $B(z) = B_0 \{1 + \epsilon \cos k(z - v_{ph}(1 + \frac{1}{2}\eta t)t)\}$ and that the initial velocity distribution is an isotropic Maxwellian. The ratio of the number of trapped particles to the total particle number is found to be $R = (\sqrt{8}/\pi)\ \epsilon^{\frac{1}{2}}\ e^{-A}\ f(y)$ for $\epsilon \ll 1$, where $A = mv_{ph}^2/2T$, $y = 2\eta A/\epsilon k v_{ph}$ and f(y) is a monotonically decreasing function of y ($f(0) = 1$). The function f(y) is presented in a graph as well as a table. As an application of the formula, an estimation is made on the required RF power for sustaining the plasma current in Golovin's model of the Tokamak fusion reactor. (auth)

32683 (IPPJ-191) THEORY AND EXPERIMENT ON RF PLUGGING OF MAGNETICALLY CONFINED PLASMA IN AN OPEN-ENDED SYSTEM. Watari, T.; Hiroe, S.; Sato, T.; Ichimaru, S. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1974. 58p. INIS.

The theory of an r.f. plugging of a magnetically confined plasma in an open-ended system is presented; it takes explicit account of the collective effect brought about by the dynamic screening action of the plasma. The theory predicts a maximum efficiency of the r.f. plugging at an optimum frequency corresponding to a zero of the longitudinal dielectric constant. The plugging efficiency is calculated as a function of the plasma density, the strength of the r.f. field, and the intensity of the magnetic field. These theoretical predictions are compared with the experimental observations, demonstrating a satisfactory agreement in overall features. The results provide a useful scaling law associated with the concept of the r.f. confinement. The theory also offers an adequate explanation for the discrepancy between the experimental values of the optimum frequency and those predicted by a conventional theory based on an individual-particle model. (auth)

32684 (IPPJ-192) CONCEPT FOR A DOUBLE CUSP FUSION REACTOR WITH THE ADIABATIC RF PLUGGING. Hatori, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1974. 32p. INIS.

The adiabatic rf plugging scheme is proved to be efficient enough when it is applied to a cusp system, and a possible prototype of a fusion reactor is sketched. The proposed system is composed of two cylindrically symmetric cusp geometries and a long central section, of about 100 m, connecting them. In the line and the point cusp regions an rf field with the frequency of the order of the ion cyclotron frequency is applied to suppress the end loss. In contrast with the conventional mirrors, the confinement mechanism is independent of ion collisions, so that a moderate plasma temperature, for instance 20 KeV, is allowed, and also the confinement time is proportional to the system length. This scheme has a high purity advantage over the toroidal systems. The frequency of the rf field is properly set so that the rf barrier reflects only deuterons and tritons and is insensitive to heavy impurity ions in the low ionization stage. (auth)

32685 (IPPJ-193) ON THE FAST ION HEATING OF PLASMA. Watanabe, K.; Nishikawa, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1974. 16p. INIS.

A critical survey is given about experimental results on anoma-

lously fast ion heating, including the linear turbulent heating experiment and others, which often are said to have close correlation with the plasma turbulences. Results may not be explained consistently in terms of only the plasma turbulence, usually considered so far. We intend to give a comment suggesting another mechanism of fast ion heating, named the turbulent macroscopic process. It is associated with a macroscopic motion of plasma, or an instability of long wavelength fluctuations, which was set in as a result of the change of plasma parameters of discharge column, the parameter change being originated from the usual high-frequency short-wavelength plasma instabilities. (auth)

32686 (N-74-26188) INVESTIGATION OF THE PROCESS OF SIMPLE WAVE INVERSION IN AN ANISOTROPIC PLASMA. Ruderman, M. S. (AN SSSR, Moscow). 1974. Translation of PR-149. (NASA-TT-F-15671). 25p. NTIS $4.25.

The inversion path of simple waves in anisotropic plasma is determined on the basis of the Chew, Goldberg, and Low equations. The validity of applying the linear theory to the question of heating of the outer solar corona by rapid magnetosonic waves was studied. (auth)

32687 (ORO-4338-5) CONTINUATION OF RESEARCH ON NONLINEAR PLASMA PHENOMENA AND AN INVESTIGATION OF TURBULENT HEATING SCHEMES. Annual Progress Report. Jones, W. D.; Oleson, N. L. (University of South Florida, Tampa (USA). Dept. of Physics). 15 Mar 1975. Contract AT(40-1)-4338. 27p. Dep. NTIS $4.50.

Effort during the period was devoted to the design and construction of a turbulence-heating plasma facility and the associated diagnostics. The basic Z-pinch has now been successfully operating for two months, the majority of the diagnostics have been set up and tested, and some preliminary measurements of the plasma have been made. The plasma exhibits anomalous resistivity and heating is clearly present. A large-volume "double-plasma" multipole facility was almost completed. Not only can this device be effectively utilized for testing diagnostics and rf coupling schemes for the heating experiment, but also for independently studying nonlinear processes which are thought to be responsible for the plasma heating. The behavior of ion acoustic waves in double-electron-temperature plasmas was studied. The main result is that the propagation behavior of the waves is dominated by the low-temperature electron component, even when such a component represents only a small fraction of the total plasma density. It is suggested that low-frequency electrostatic plasma phenomena, in general, can be strongly modified if cold electrons are present. (auth)

32688 (UCRL-Trans-10823) PLASMA HEATING ASSOCIATED WITH DEVELOPMENT OF PARAMETRIC TURBULENCE NEAR THE LOWER HYBRID FREQUENCY. Demirkhanov, R. A.; Khorasanov, G. L.; Sidorova, I. K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Sukhumi. Fiziko-Tekhnicheskij Inst.). Feb 1975. Translation of SFTI-5. 18p. Dep. NTIS $4.00.

The possibility of heating a plasma in the turbulent regime, appearing under the effects of strong radiation whose frequency is close to the lower side of the high-frequency plasma oscillation $^{W}LE(K_{z}/K)$ is discussed. Some experimental results on the parametric heating of the alkali plasma in the Q machine are reported. The effect of abnormal absorption of the high-frequency power, detected in these experiments, indicates that the region of lower hybrid frequencies ($\lambda \simeq 3$ to 10 cm) can be used for the effective heating of a plasma in a toroidal system. (tr-auth)

32689 LASER PRODUCED PLASMA HEATED BY TWO SIMULTANEOUS LASER PULSES. Dragila, R.; Loncar, G. (Faculty of Technical and Nuclear Physics, Department of Physical Electronics, Prague, Czechoslovakia). Phys. Lett., A; 50: No. 6, 422(13 Jan 1975).

A single-laser-pulse plasma heating and that of two simultaneous pulses with different frequencies and the same front pulse shaping are compared in a one-dimensional model. (auth)

32690 SOLUTION OF TROESCH'S TWO-POINT BOUNDARY VALUE PROBLEM BY SHOOTING TECHNIQUE. Kubicek, M.; Hlavacek, V. (Inst. of Chemical Tech., Prague). J. Comput. Phys.; 17: No. 1, 95-101(Jan 1975).

Two techniques are shown which render the numerical solution of the Troesch's equation almost trivial. The first method is based on an appropriate transformation which expands the length of the interval, the second method makes use of the exchange of independent for dependent variables. The former approach is sometimes referred to as the parameter mapping technique. (MOW)

32691 Z-PINCH DYNAMICS FROM THE GENERALIZED BENNETT RELATION. Witalis, E. A. (National Defense Research Inst., Stockholm). Phys. Rev., A; 10: No. 6, 2373-2377 (Dec 1974).

The plasma virial theorem is derived from the equation of mass motion and evaluated for rotationally field-symmetric configurations so as to yield a general dynamic Bennett relation. The acceleration term is formulated in different ways. Magnitudes of expansional and compressional terms are discussed. The relation extends the recent Baker–Phillips result that magnetic field diffusion has a deconfining action in the late stage of z pinching. (auth)

Plasma Diagnostics

32692 (IPPJ-189) SPECTROSCOPIC OBSERVATION OF A QUASISTEADY STATE OF A PLASMA ON CONTACT WITH A NEUTRAL GAS. Otsuka, M.; Ikee, R.; Ishii, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1974. 20p. INIS.

When a neutral gas (He) is introduced into the "plasma region" of the TPD machine, an intense glow was observed at the tail of a plasma column. The population densities of the excited levels of helium ion He^{+} in the glow plasma were found to be much larger than those values expected in a steady state which had the same values of electron temperature and density as the observed one; it is shown that the plasma should be considered to be in a quasi-steady state. (auth)

32693 EVALUATION OF THE BOHM SHEATH CRITERION FOR ION DENSITY DETERMINATIONS. Prokopenko, S. M. L.; Goodings, J. M. (York Univ., Toronto). Can. J. Phys.; 52: No. 24, 2459-2462(15 Dec 1974).

The Bohm sheath criterion requiring a minimum ion energy $\frac{1}{2}kT_{e}$ for sheath formation at a plasma boundary is discussed in connection with ion density determinations for planar, cylindrical, and spherical collection geometry. For truly planar geometry (i.e., an infinite plane collector) the ions must gain a large directed energy in the presheath (e.g., $>3.5kT_{e}$ for $kT_{e} = 1$ eV) which will always exceed the Bohm minimum energy before a sheath is formed. In fact, Langmuir's original ion equation is applicable, and is compatible with the Bohm sheath criterion for the specific case of planar geometry. For cylindrical and spherical geometry, the necessary directed ion energy lies closer to, or may even equal, the Bohm minimum energy; however, uncertainty in the exact amount of directed energy required for sheath formation could lead to ion density determinations involving errors of nearly an order of magnitude in the two cases. (auth)

32694 MEASUREMENT OF NON-MAXWELLIAN ELECTRON DISTRIBUTION FUNCTIONS IN HOT PLASMA AND THE IMPORTANCE FOR THOMSON SCATTERING DIAGNOSTICS. Segre, S. E.; Pieroni, L. (Massachusetts Inst. of Tech., Cambridge (USA)). Phys. Lett., A; 51: No. 1, 25-26(27 Jan 1975).

Thomson scattering measurements show that non-Maxwellian electron distribution functions can occur in Tokamak plasma when the ratio of electron drift velocity to thermal velocity, v_{D}/v_{th}, is $v_{D}/v_{th} \gtrsim 0.1$. Consequences for Thomson scattering diagnostics are discussed. (auth)

32695 ACTIVE SUBMILLIMETER DIAGNOSTICS OF THE PLASMA OF A COLUMN UHF DISCHARGE AT HIGH PRESSURE. Tishchenko, E. A.; Zatsepin, V. G. (Physics Lab., Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 2, 547-561(Feb 1975). (In Russian).

The technical and methodological aspects of active submillimeter diagnostics of the plasma of a column discharge rotating along irregular trajectories around the axis of an uhf cavity under the action of a stabilizing gas flow are described. The rotation is employed for transverse probing of the column by means of converging microwave beams which are sufficiently narrow compared to the characteristic column diameter. The cut-off method for determining the maximal electron density at the axis of a radially inhomogeneous plasma cylinder under strongly refractive conditions is substantiated and generalized in the quasi-optical approximation. The accuracy of the results obtained by the cut-off method (estimated to be ~10%) is confirmed by observations of signals reflected by the plasma. A method is developed for measuring the characteristic column diameters at a level of 10% of the maximal concentration. Simultaneous four-frequency transverse probing is employed for determining the electron concentration distribution function averaged over the probing beam width. The maximal electron concentration (10^{15} to 10^{16} cm^{-3}) and characteristic diameter (2 to 10 mm) of a discharge in deuterium are measured in a small plasma installation at a gas pressure of 1 to 2 atm. and uhf input power of 4 to 12 kW. In a plasma installation of three times greater size the values of these parameters are correspondingly 10^{15} to 10^{17} cm^{-3} and 4 to 25 mm at pressures between 1 and 5 atm. and an input power between 15 and 40 kW. For equal pressures and electron concentrations the diameters of the large installation plasma column is almost three times that in the small instal-

lation. With increase of pressure at a fixed power the column diameter decreases. Time-dependent fluctuations of the plasma column structure and also of the electron concentration profile with an abrupt jump of density near the axis are observed. (auth)

32696 MEASUREMENT OF PLASMA POTENTIAL ACCORDING TO THE TIME OF FLIGHT OF HEAVY IONS. Vdovin, S. A.; Kalmykov, A. A.; Lavrent'ev, O. A.; Naboka, V. A.; Pankrat'ev, Yu. I. (Inst. of Physics and Tech., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 17: No. 4, 1112-1115(1974).

Translated from Prib. Tekh. Eksp.; 17: No. 4, 145-147(1974).

A circuit for measuring plasma potential by the method of active corpuscular diagnostics is described. The plasma was probed by a beam of heavy Ar^+ and Kr^+ ions having energies of 4 to 10 keV. The average plasma potential was measured according to the time of flight of the ion beam through the plasma. The variation of the time of flight was recorded directly by means of an oscilloscope. (auth)

32697 SPECTROMETRIC PLASMA DIAGNOSTICS. Cabannes, F. (CNRS, Orleans-la-Source, France). Pure Appl. Chem.; 39: No. 3, 381-394(1974).

From international symposium on plasma chemistry; Kiel, Ger. (6 Sep 1973).

Some plasma chemistry work done in France during the past three years is described, i.e., measurements of transition probabilities and line profiles by J. Chapelle; calculations on non-LTE hydrogen and helium plasmas by H. W. Drawin; and application of N_2^+ and N_2 bands in the diagnosis of nitrogen plasma jets as treated by P. Fauchais. (auth)

Plasma Kinetics (General)

32698 (AD/A-000145) INVESTIGATION OF PLASMA FOCUS IN COAXIAL ACCELERATOR WITH PREIONIZATION OF GAS. Kvartskhave, I. F.; Khautiev, E. Yu. 3 Oct 1974. Translated by M. Olaechea from pp 247-50 of Plazmennye Uskoriteli, Moscow, 1973. (FTD-HT-23-1088-74). 12p. NTIS $3.25.

Several possible direct applications of coaxial electrodynamic plasma accelerators for thermonuclear purposes have recently been discovered. It appears that when the accelerating current beyond the end of the central electrodes has sufficiently high levels a plasma focus is formed which is distinguished by its high plasma density and temperature as well as by its significant yield of thermonuclear neutrons. The main properties of the plasma focus in a system with a pre-ionized gas, achieved by means of an inductive electrical field, are examined. (GRA)

32699 (AD/A-000637) ION ACCELERATION MECHANISM IN CURRENT LAYER IN CASE WHERE INSTABILITY DEVELOPS. Arefev, V. M.; Leskov, L. V. 4 Oct 1974. Translated by M. Olaechea from pp 191-195 of Plazmennye Uskoriteli, Moscow, 1973. (FTD-HT-23-1073-74). 14p. NTIS $3.25.

In experiments on nonstationary plasma acceleration it was established that under certain conditions behind the current front turbulent processes develop which lead to high-frequency oscillations, anomalous plasma resistance, and the appearance of fast particles whose energy greatly exceeds the applied potential difference. The paper presents a theoretical analysis of the current instabilities which develop when a plasma is accelerated. (GRA)

32700 (CEA-CONF-2887) PROCESSES IN EARLY AFTERFLOWS. Deloche, R.; Sayer, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Atomique). [nd]. 3p. (CONF-740998-1). Dep. NTIS (US Sales Only) $4.00.

From 2nd European study conference on atomic and molecular physics of ionized gases; Innsbruck, Austria (3 Sep 1974).

The purpose of this paper is neither to present an exhaustive study of all the physical processes occurring in early afterglows nor to survey all the cases which may be encountered in various experimental conditions. It is restricted to the presentation of some general characteristics of afterflows and indicates, by a few examples, how it is possible to give a precise interpretation of the experimental observations. (auth)

32701 PARTIALLY IONIZED GASES. Mitchner, M.; Kruger, C. H. Jr. Wiley Series in Plasma Physics. New York; John Wiley and Sons, Inc. (1973). 527p. $27.50.

The general features of collision dominated partially ionized gases are outlined. The flow of ionized gases in the presence of electric and magnetic fields is described. The following chapters are included: (1) collisional and radiative processes, (2) plasmas, (3) magnetohydrodynamics, (4) collision theory, (5) radiation theory, (6) kinetic theory, (7) transport properties, and (8) ionization equilibrium. (MOW)

32702 RISE OF STRUCTURES AT THE SELF-PRESERVING MODE OF PLASMA CONTRACTION. Zmitrenko, N. V.; Kurdyumov, S. P. (Inst. of Applied Mathematics, Moscow). Dokl. Akad. Nauk SSSR; 219: No. 3, 578-581(21 Nov 1974). (In Russian).

A new class of self-preserving solutions for the problem of compression of a finite mass of plasma by a piston with specified hydrodynamic and thermal regimes in the plasma was studied. The plasma is described by a one-dimensional hydrodynamic equation with consideration of the temperature break, a series of dissipation processes, the volume discharge, and the heat source. Cases of plane, axial, and central symmetry were examined. Possible forms of solutions of the self-preserving problem of the compression of a finite mass were examined. (JSR)

32703 SELF-PRESERVING MODE OF PLASMA FINITE MASS COMPRESSION. Zmitrenko, N. V.; Kurdyumov, S. P. (Inst. of Applied Mathematics, Moscow). Dokl. Akad. Nauk SSSR; 218: No. 6, 1306-1309(21 Oct 1974). (In Russian).

A new class of self-preserving solutions are examined for the problem of the compression of a finite mass of plasma by a piston with specified hydrodynamic and thermal regime in the plasma. Analytical solutions were found for particular cases. In the modes examined the change of the plasma parameters were determined exclusively by the boundary modes and the free plasma. (JSR)

32704 BREMSSTRAHLUNG INSTABILITY AND COHERENT AMPLIFICATION OF POLARIZED RADIATION IN A PLASMA LOCATED IN A MAGNETIC FIELD. Sazonov, V. N.; Tuganov, V. F. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 67: No. 6, 2157-2160(Dec 1974). (In Russian).

Due to collisions with ions the electrons in a plasma located in a magnetic field H may amplify radiation polarized in the (k, H) plane, where k is the wave vector. Radiation polarized perpendicular to the (k, H) plane is absorbed. It is shown that for a magnetic field such that $eH/mc \gg \omega$ amplification of radiation of frequency ω may be possible even for an isotropic distribution of electron momenta. This contrasts to the case of a plasma without a field when amplification is possible only if the electron distribution is of the beam type. (auth)

32705 NATURE OF BALL LIGHTENING. Voitsekhovskii, B. V.; Voitsekhovskii, B. B. (Academy of Sciences, Novosibirsk, USSR). Dokl. Akad. Nauk SSSR; 218: No. 1, 77-80(1 Sep 1974). (In Russian).

A mechanism for the formation, movement, and disappearance of ball lightening is proposed. The proposed mechanism includes the transfer of an air mass with the formation of a leading projection under the influence of electrostatic forces originating because of the nonequilibrium distribution of excess charges in the air. The disappearance of the ball lightening occurs during increase of the intensity of the field above breakdown. The concept will also explain bead lightening. All characteristics of ball lightening were qualitatively explained. The difference between ball lightening and linear lightening is discussed. (JSR)

32706 SELECTIVE RELAXATION OF LONG-LIVED STATES OF METAL ATOMS IN A GAS-DISCHARGE PLASMA. Stationary Generation on $^1P_1^0 - {}^1D_2$ Transitions of Calcium and Strontium. Kimkin, V. M.; Monastyrev, S. S.; Prokop'ev, V. E. (Inst. of Atmospheric Optics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 20: No. 4, 110-111(20 Aug 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 20: No. 4, 251-253(20 Aug 1974).

Selective relaxation of metastable states of alkali-earth metals was effected in a hot-discharge plasma. This has made it possible to realize for the first time stationary lasing on transitions from resonant to metastable levels. (auth)

32707 THYRISTORIZED POWER SUPPLY FOR A 20 KW-PLASMATRON. Bendschneider, G.; Hoffmann, H.; Knapschinsky, L. (Central Inst. for Physical Chemistry, Berlin). Exp. Tech. Phys.; 22: No. 2, 155-160(1974). (In German).

A thyristorized power supply with good control action was developed for a plasmatron. The energy losses of this unit were minimized, so that more than 85% of energy taken from the network are available for the plasmatron. Different carrier gases (argon, nitrogen, hydrogen) may be used without modifying the equipment. (auth)

Plasma Kinetics (Experimental)

32708 (EUR-5064e, pp 191-242) REVIEW OF LOW-β TOROIDAL MACHINES. Von Gierke, G. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nov 1974.

In international school of plasma physics, Varenna on Lake Como, Italy, September 27–October 9, 1971. Course on instabilities and confinement in toroidal plasmas.

Some experimental results concerning low-beta devices are reviewed. The experimental results cover: (1) internal ring devices, (2) l = 2 and l = 3 stellarators, (3) the main properties of tokamak discharges, (4) equilibrium and stability of tokamak discharges, and (5) the effect of nonaxisymmetry of tokamaks. (MOW)

32709 (IPPJ–185) SELF-MODULATION OF HIGH FREQUENCY ELECTRIC FIELD AND FORMATION OF CAVITIES IN PLASMA. Ikezi, H.; Nishikawa, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1974. 11p. INIS.

The self-modulation of the oscillating electric field is observed when its frequency is near the electron plasma frequency. The localized field due to the self-modulation is found to make depression in the plasma density. (auth)

Plasma Kinetics (Theoretical)

32710 (COO-2456-4) HIGH BETA PLASMA RESEARCH. Progress Report, May 1, 1974–January 31, 1975. Chu, C. K.; Gross, R. A. (Columbia Univ., New York (USA)). 1 Feb 1975. Contract AT(11-1)-2456. 14p. Dep. NTIS $4.00.

A materials testing section was built and installed on the plasma shock tube. Sample wall materials tests, IR data to determine $\langle Z^3 \rangle$, and energy transport processes near the wall, are being studied. A high-beta axisymmetric torus has been studied and a new machine designed. Computer simulation studies are progressing in initial-value problems, equilibrium, stability and heating for toroidal systems. (auth)

32711 (EUR-5064e, pp 55-61) ANALOGY BETWEEN TURBULENT TRANSFER IN VELOCITY SPACE AND PLASMA COLLISIONAL TRANSPORT IN REAL SPACE. Coppi, B. (Massachusetts Inst. of Tech., Cambridge); Santini, F. Nov 1974.

In international school of plasma physics, Varenna on Lake Como, Italy, September 27–October 9, 1971. Course on instabilities and confinement in toroidal plasmas.

An analogy between the plasma transport across a magnetic field due to ion-ion collisions and the transport of momentum in velocity space in the presence of plasma fluctuations of small amplitudes is pointed out. The latter process, connected with particle trapping in electrostatic waves, can be proposed as a model to explain the observed lack of runaway processes in confined plasmas on which a relatively strong electric field is applied. (auth)

32712 (EUR-5064e, pp 91-107) SOME PROPERTIES OF ISODYNAMICAL EQUILIBRIUM CONFIGURATIONS AND OF THEIR GENERALIZATION. Palumbo, D. (EURATOM, Brussels). Nov 1974.

In international school of plasma physics, Varenna on Lake Como, Italy, September 27–October 9, 1971. Course on instabilities and confinement in toroidal plasmas.

The problem of toroidal equilibrium configurations in ideal MHD is considered in the case of isotropic pressure P and under the assumption that the drift surfaces and the magnetic surfaces coincide. A sufficient but not necessary condition is the constancy of the magnetic field H on each magnetic surface, hence the name of "isodynamic." A general property of these configurations is that, without changing the geometry of the magnetic surfaces and of the H lines, pressure profiles can be chosen arbitrarily. The case of an axisymmetrical torus is summarized. The isodynamic axisymmetrical equilibrium is unstable in all cases of practical interest but, without changing the magnetic surfaces, more general equilibria can be obtained for which pressure profile can again be arbitrarily chosen. (auth)

32713 (EUR-5064e, pp 109-143) TRANSPORT THEORY FOR TOROIDAL PLASMAS. Stringer, T. E. (Culham Lab., Abingdon, Eng.). Nov 1974.

In international school of plasma physics, Varenna on Lake Como, Italy, September 27–October 9, 1971. Course on instabilities and confinement in toroidal plasmas.

Plasma transport theory is described for the following four regimes: (1) the collision dominated plasma, (2) the intermediate collisional regime, (3) the banana regime, and (4) transport theory for stellarators. Solutions are given for some nonlinear cases. (MOW)

32714 (EUR-5064e, pp 351-373) NUMERICAL SIMULATION OF THE BEHAVIOR OF TOROIDAL PLASMAS. Roberts, K. V. (Culham Lab., Abingdon, Eng.). Nov 1974.

In international school of plasma physics, Varenna on Lake Como, Italy, September 27–October 9, 1971. Course on instabilities and confinement in toroidal plasmas.

The following four lectures are given: (1) numerical calculations in plasma physics, (2) numerical solution of the Vlasov and Fokker–Planck equations, (3) numerical solution of the magnetohydrodynamic equations, and (4) a unified approach to the solution of the initial value problem. (MOW)

32715 (EUR-5064e, pp 375-411) NUMERICAL SIMULATION. Winsor, N. K. (Princeton Univ., NJ). Nov 1974.

In international school of plasma physics, Varenna on Lake Como, Italy, September 27–October 9, 1971. Course on instabilities and confinement in toroidal plasmas.

Some general simulation techniques are outlined, e.g., particle simulation, Vlasov simulation, fluid simulation, hybrid simulation, and one-, two-, and three-dimensional toroidal models. A low-beta fluid code is examined in particular. It simulates mass transport and diffusion in a confined plasma with convection. (MOW)

32716 KINETIC EQUATIONS OF FLUIDS AND PLASMA. Rabuel-Peyrissac, J. P. Cours et Documents de Matematiques et de Physique. New York; Gordon and Breach, Science Publishers, Inc. (1974). 317p. (In French). $36.50.

The concepts necessary for a comprehension of modern studies on kinetic equations are compiled, discussed, and generalized in order to give the basic elements of statistical mechanics. After a review of the classic theory of corpuscular collisions, it is shown that the concept of scattering cross section in triple or higher collisions must be treated directly by the Liouville equation or the BBGKY method. With respect to the representation of a system and its magnitudes, in addition to the usual concepts considered, the Green function is introduced and it is shown how well adapted it is to the analysis of the behavior of a disordered system. The fine distribution functions, used in the study of plasmas and their fluctuations, are introduced. The origin and possible applications of the Boltzmann equation are given and the equation is then generalized. The Sandri extension method is described. The study of hydrodynamics or the theory of classical plasmas is a general survey of the various approximations. Some practical results on the transport coefficient are found. (JSR)

32717 MANY-PARTICLE NUMERICAL SIMULATION OF PARAMAGNETIC AND DIAMAGNETIC REGIMES IN TOKAMAKS. Sestero, A. (CNEN-EURATOM, Rome); Bittoni, E.; Taroni, A. Lett. Nuovo Cim.; 12: No. 3, 69-74(18 Jan 1975).

The simulation considers particles of one species only interacting with each other through the magnetic field and the inductive electric field, but not through the Coulomb electric field which is disregarded. A one-dimensional cylindrical geometry is used. There is no resistivity used in the model. Thus the success of the simulation indicates that the nature of the conductivity tensor plays only a marginal role in the dynamics of paramagnetic-diamagnetic transitions occurring in tokamak plasmas. (MOW)

32718 MEAN FIELD IN A RANDOMLY-INHOMOGENEOUS HEATED PLASMA AND ENERGETIC LOSSES OF MOVING CHARGED PARTICLES. Abramovich, B. S.; Ryzhov, Yu. A. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 11, 1591-1598(1974). (In Russian).

The problems of electrodynamics of heated plasma with random macroscopic fluctuations of the electron density are considered. The effective dielectric permittivity of plasma near the resonance frequency is found by a quasi-hydrodynamic method. It is shown that in the case of small-scale inhomogeneities (in the scale of the field wavelength) the main process responsible for the character of source radiation, immersed in an inhomogeneous plasma, is the scattering of the field into plasma chaotic waves. The role of spatial dispersion caused both by macroscopic inhomogeneity of the medium and thermal motion of plasma particles is elucidated by the example of the problem of radiation from a charged particle moving with the constant velocity through such a randomly-inhomogeneous plasma. Expressions are derived for energy losses of charged particles moving in the inhomogeneous plasma at the frequencies close to the resonance frequency. (auth)

32719 STATISTUCHESKAYA FIZIKA PLAZMY. (Statistical Plasma Physics). Kudrin, L. P. Moscow; Atomizdat (1974). 496p.

The contemporary status of statistical plasma physics is examined. Special attention is given to methods for the calculation of the thermodynamic functions of both classical and quantum equilibrium systems. The thermodynamics of completely and partially ionized gases and metal plasmas are discussed and methods are described for the experimental diagnosis of dense plasmas. The book is not completely methodological although attention is given to the different approaches to the solution of

individual problems. The discussion demonstrates the diversity of the methods of theoretical physics that can be used to study plasma physics. (tr-auth)

32720 APPROXIMATION OF THE HYDROMECHANIC–THERMODYNAMICAL FUNDAMENTAL EQUATIONS FOR THE CASE OF NON-RELATIVISTIC VELOCITIES TAKING INTO ACCOUNT THE CONDUCTIVE MOMENTUM DENSITY. Schmutzer, E. (Univ., Jena, Ger.). Exp. Tech. Phys.; 22: No. 5, 373-386(1974). (In German).

The general relativistic equation of motion for a continuum and the corresponding mass balance equation are approximately treated for nonrelativistic velocities, but taking into account the conductive momentum density, caused by the irreversible effects. One finds a new force term and a modification of the mass balance equation, both becoming very important, if the irreversible processes being involved must not be neglected (i.e., nuclear processes in plasmas). (auth)

32721 NORMAL MODE ANALYSIS OF MAGNETOPLASMA EXCITATIONS IN QUANTUM PLASMA. Katayama, S.; Yokota, I. (Niigata Univ. (Japan). Dept. of Physics). J. Phys. Soc. Jap.; 36: No. 5, 1428-1436(May 1974).

Magnetoplasma excitations in Voigt configuration are investigated by means of normal mode analysis. It is proved that the dynamical self-consistent field approximation is equivalent to RPA plus replacing the double integral appeared in the Coulomb interaction with the product of two single integrals with an appropriate factor. The expressions for the photon strengths, for the f-sum and for the dynamical form factors are derived by the use of the normal mode operators. When the cyclotron frequency is of the same order of magnitude as the plasma frequency realizable in highly doped semiconductors, several interesting features are found in excitation spectra. Contributions to the f-sum, to the photon strength, and to the dynamical form factor from each of the normal model are numerically calculated. (auth)

32722 COMPUTER SIMULATION OF THE TOROIDAL EQUILIBRIUM AND STABILITY OF A PLASMA IN THREE DIMENSIONS. Betancourt, O.; Garabedian, P. (New York Univ., NY). Proc. Nat. Acad. Sci. U. S. A.; 72: No. 3, 926-927(Mar 1975).

A computer program was written to solve the equations for sharp boundary magnetohydrodynamic equilibrium of a toroidal plasma in three dimensions without restriction to axial symmetry. The numerical method is based on a variational principle that indicates whether the equilibria obtained are stable. Applications were made to Tokamak, Stellarator, and Scyllac configurations. (auth)

32723 SLOWING DOWN OF FAST PROTONS IN A PLASMA WITH A STRONG MAGNETIC FIELD. Basko, M. M.; Syunyaev, R. A. (Inst. of Applied Mathematics, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 1, 105-110(Jan 1975). (In Russian).

In a plasma with a strong magnetic field such that $H > H_0 = 2.2 \times 10^{13}\ (v/c)^2$ G, the range of protons moving along field lines of force is considerably increased, and Coulomb energy losses are reduced as a result of quantization of energy of transverse electron motion. The primary factor in this case is proton diffusion at angles with respect to the magnetic field direction since the losses strongly depend on the angle. Consequently, the Coulomb range increases $(M/m)^{1/2}$ times compared to the range in a plasma without a magnetic field. Since Coulomb losses are small the slowing down of protons is determined by nuclear collisions. For $16\ \pi\mu_0 N_e mc^2/kT < H < H_0$ and a high proton velocity $\hbar v/e^2 \gg 1$, the range increases in accordance with decrease of the Coulomb logarithm in which the Larmor radius of zero Landau level should be substituted for the Debye radius. Here μ_0 is the Bohr magneton. (auth)

32724 USE OF THE SPECTRAL METHOD FOR TWO- AND THREE-DIMENSIONAL GUIDING CENTER PLASMAS. Salu, Y.; Knorr, G. (Univ. of Iowa, Iowa City). J. Comput. Phys.; 17: No. 1, 68-78(Jan 1975).

The spectral method is reviewed and then applied to equations of two- and three-dimensional guiding center plasmas. Some linear and nonlinear phenomena were studied. It is shown that the spectral method can be used on a wide range of problems. (auth)

32725 COMPARISON OF THREE TWO-DIMENSIONAL ELECTROSTATIC PLASMA SIMULATION MODELS. Lewis, H. R.; Nielson, C. W. (Los Alamos Scientific Lab., NM). J. Comput. Phys.; 17: No. 1, 1-9(Jan 1975).

Three two-dimensional plasma simulation models were compared using an electrostatic two-stream instability as a test case. In one model the usual five-point Laplacian was used in Poisson's equation, and the field was smoothed by interpolation with a bilinear spline function. In another model the difference approximation to the Laplacian was the nine-point operator prescribed by Hamilton's variational principle, and the electric field was computed as the exact negative gradient of the potential. In the third model the nine-point Laplacian was used with the smoothed field. The test problem was an unstable double-streaming plasma that was initially cold in the streaming direction. The major result is that the evolution of electric field energy did not depend strongly on the choice of model. There was a much stronger dependence on the random numbers that were selected to represent the initial velocity distribution. (auth)

32726 CORONAL EQUILIBRIUM OF HIGH-ATOMIC-NUMBER PLASMAS. Mosher, D. (Naval Research Lab., Washington, DC). Phys. Rev., A; 10: No. 6, 2330-2335(Dec 1974).

The distribution of ionization states in carbon, aluminum, copper, and tungsten plasmas was determined from the corona-model equilibrium. The variations of mean ionization level, internal energy, and radiation rates for continuum and lines with temperature are then determined by averaging over the ionization states. Results can be applied to studies of a variety of existing laboratory plasmas and to analyses of the effects of impurities in fusion plasmas. (auth)

32727 FLUID SIMULATION OF A LOW-PRESSURE AXI-SYMMETRIC TOROIDAL PLASMA USING NATURAL COORDINATES. Grimm, R. C.; Johnson, J. L. (Princeton Univ., NJ). J. Comput. Phys.; 17: No. 2, 192-208(Feb 1975).

A numerical model was developed to study the confinement of low-pressure plasmas in axially symmetric configurations with arbitrary shaped magnetic surfaces. The equations contain the effects of resistivity, plasma inertia, and pressure gradients in the surfaces. In this model, which extends the earlier work in which fictitious currents had to be introduced to support the magnetic fields, the plasma pressure is taken sufficiently small that only electrostatic modes can be excited. The Lax-Wendroff scheme is used to advance the plasma density and velocities in time. Applications include demonstration that classical expressions for diffusion are valid when there are small plasma flows and study of the propagation of acoustic and geodesic waves in levitrons. (auth)

32728 PARTIAL CROSS SECTIONS IN A PLASMA. Istomin, V. V.; Dovgopol, S. P. (Ural Polytechnical Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 68-71(1974). (In Russian).

The collision integral for plasma, obtained in the framework or the circular approximation with preliminary ladder renormalization, was used to determine the first two partial cross sections. The numerical calculations showed that the partial cross sections must have a substantially nonlinear form in the logarithmic scale and do not diverge at small values of the plasma parameters. (tr-auth)

32729 FLOW OF A WEAKLY IONIZED GAS BETWEEN PARALLEL COLD WALLS WITH PARABOLIC VELOCITY PROFILE. Puspak, S. N.; Srivastava, K. M. (Univ., Jodhpur, India). Proc. Indian Acad. Sci., Sect. A; 80: No. 5, 241-248 (Nov 1974).

Ambipolar diffusion between flat cold insulating walls of a weakly ionized gas which flows in the direction parallel to the walls with parabolic velocity profile was investigated theoretically. It was found that: (1) the patched velocity of linear and nonlinear regions tends to $1/\sqrt{2}$ of the thermal velocity, (2) the thickness of the nonlinear region with parabolic velocity profile is found to be less than that of Shioda who considered uniform streaming (J. Phys. Soc. Japan, 1969, 29, 197), and (3) the number density and the electric potential approximations in the sheath edge do not depend upon x, the coordinate in the streaming direction. (auth)

32730 TURBULENCE SPECTRUM OF A LANGMUIR CONDENSATION. Khakimov, F. Kh.; Tsytovich, V. N. (Tadzhik State Univ., Dyushambe, USSR). Zh. Eksp. Teor. Fiz.; 68: No. 1, 95-104(Jan 1975). (In Russian).

It is demonstrated that a strong Langmuir turbulence produced by a Langmuir condensation leads to $W_k \propto 1/k^2$ spectra which is in agreement with existing results on numerical simulation of strong turbulence. (auth)

32731 TRANSPORT PROPERTIES FOR A COLLISIONLESS PLASMA FROM FINITE-LARMOR-RADIUS EQUATIONS IN GENERAL MAGNETIC FIELDS. Srivastava, M. P.; Bhatnagar, P. L. (Dept. of Physics, Delhi). Beitr. Plasmaphys.; 14: No. 3, 79-92(1974).

The Vlasov equation was studied in a local system of coordinates defined by the curved magnetic field. The distribution function was expanded in terms of a small parameter ϵ which is the ratio of ion Larmor radius to the characteristic length in the direction perpendicular to magnetic field. Assuming an approx-

imation for the distribution function, which is consistent with physical systems, transport properties were obtained in different orders of approximation taking account of the general heat flux vector. One finds that there are additional terms appearing in the components of stresses due to the parallel energy flow term in the heat flux vector. (auth)

32732 RELAXATION OSCILLATIONS OF PARAMETRIC TURBULENCE. Pustovalov, V. V.; Romanov, A. B.; Silin, V. P.; Tikhonchuk, V. T. (Levedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 20: No. 6, 160-161(20 Sep 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 20: No. 6, 356-359(20 Sep 1974).

It is shown that a magnetic field alters significantly the previously known laws of parametric-turbulence relaxation. Undamped periodic oscillations of the plasma-noise intensity can arise in the nearer-threshold region of parametric instability. Such a system can serve as a generator for relaxation oscillations of electric fields. (auth)

Plasma Production

Refer also to abstract 32689.

32733 (EPRI-SR-9) LASER-FUSION PROGRAM SUMMARY REPORT. Isaacson, L. K. (Electric Power Research Inst., Palo Alto, Calif. (USA)). Feb 1975. 50p. Dep. NTIS $4.00.

A brief summary of the ERDA laser-fusion program and a brief review of several major laboratory programs in the laser-fusion program are presented. In addition, comments are made on laser development efforts and laser-fusion power systems analyses. This report is not intended to be a thorough review of the total program in laser fusion, but is only a brief overview of the major aspects of the program at this point. (auth)

32734 (IPPJ-T-19) HYDROGEN OCCLUSION OF TITANIUM WASHERS FOR THE TITANIUM PLASMA SOURCE. Nakagawa, Y. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1974. 5p. INIS.

A new procedure to make the titanium washers having absorbed the hydrogen of the most desirable amount (Ti; H = 1; 1) for titanium plasma source is described. In electric furnace at some time after the beginning of the temperature rise of titanium by reaction heat titanium washers are quickly cooled by dragging it out from high temperature part to room temperature part of the electric furnace. By this procedure the amount of hydrogen absorbed by titanium washer can be controlled and the most desirable titanium washer for titanium plasma source can be obtained. (auth)

32735 (RLO-2225-T-28-2) INTERACTION OF MAGNETICALLY CONFINED PLASMAS WITH INTENSE RADIATION FROM AN ELECTRON BEAM STABILIZED CO_2 LASER. Annual Report. Vlases, G. C. (Washington Univ., Seattle (USA)). 1974. 56p. Dep. NTIS $6.00.

The further development of a powerful, e-beam stabilized CO_2 laser is reported. Two diagnostic techniques were studied, i.e., Thomson scattering of ruby laser light and holographic interferometry. The scattering system was used on the θ pinch, and measurements of N_e and T_e are described. The holographic interferometer was used with the slow solenoid to take axial interferograms of the evolving laser-produced plasma. In order to study the combined effects of laser heat addition and magnetic compression, a fast rising solenoid was designed. Some theoretical studies to supplement the experimental work are reported. (MOW)

32736 (UCRL-51708) PREPARATION AND FABRICATION OF LOW-DENSITY MICROCELLULAR-FOAM LASER TARGETS. Rinde, J. A.; Stone, R. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Jan 1975. Contract W-7405-Eng-48. 11p. Dep. NTIS $4.00.

The fabrication of low-density microcellular foam for use in D,T-filled laser targets and the incorporation of hollow glass microspheres into this foam are described. Steps in the manufacture of the target are described. (auth)

32737 ANISOTROPY OF X RAYS FROM A LASER PLASMA. Krokhin, O. N.; Mikhailov, Yu. A.; Pustovalov, V. V.; Rupasov, A. A.; Silin, V. P.; Sklizkov, G. V.; Shikanov, A. S. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 20: No. 4, 105-107(20 Aug 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 20: No. 4, 239-243(20 Aug 1974).

An anisotropy was observed in the continuous x radiation from a dense laser plasma produced when plane-polarized radiation from a neodymium laser (λ = 1.06 μ) is focused on the surface of an aluminum target at a flux density q ~ 10^{14} W/cm^2. The results are discussed. (auth)

Plasma Stability

Refer also to abstracts 32786 and 32790.

32738 (AD/A-000023) MAGNETIC SHEAR AND HELICAL-FIELD AND CONDUCTING-WALL FEEDBACK STABILIZATION FOR TOROIDAL PLASMA CONFINEMENT (THETA PINCH, TOKAMAK). Final Report. Ma, B. M. (Iowa State Univ. of Science and Technology, Ames (USA). Engineering Research Inst.). Apr 1974. 80p. (ISU-ERI-AMES-74130; AFOSR-TR-74-1601). NTIS $4.75.

Based on the wave packet model, the magnetic shear required and the stability criteria for the convective drift instabilities driven by particle density gradient and electron temperature gradient are obtained and compared to existing experimental data. From some basic assumptions of magnetic flux, energy principle, and the present ordering and expansion techniques, the theoretical displacement, equilibrium, required magnetic (shear) field, and force balance equations of the plasma are derived. Theoretical results calculated from these equations and experimental data measured from the 5-meter Scyllac sector are in excellent agreement. The block diagram of helical-field feedback stabilization using the theoretical equations is proposed for the Scyllac experiments or for computer simulation. (auth)

32739 (AD/A-000583) PLASMA ENGINEERING: INSTABILITIES (AN ENGINEER'S HANDBOOK ON PLASMA INSTABILITIES). Cap, F. F. (Innsbruck Univ. (Austria). Inst. fuer Theoretische Physik). Apr 1974. 53p. (C-PD-2; AFOSR-TR-74-1710). NTIS $4.25.

This is the second partial delivery of an engineer's handbook on plasma instabilities and their use, control, stabilization and engineering application. The book will be necessary for design and feasibility studies of thermonuclear fusion and other plasma engineering devices. The following topics are discussed: Basic plasma physics (quasineutrality, plasma frequency, Debye length, collision frequency, gyro-radius, classification of plasmas, equation of state, Saha equation, Spitzer formula, plasma thermodynamics, plasma theories), the physics of instabilities (definition of mathematical and physical instabilities, unstable solutions of linear and nonlinear ordinary differential equations, linearized stability analysis, oscillations and waves, phase, phase velocity, wave number, dispersion relation, Nyquist diagram, and growth rates. (GRA)

32740 (EUR-5064e, pp 413-425) DYNAMIC STABILIZATION OF LOW FREQUENCY WAVES IN INHOMOGENEOUS PLASMAS. Dobrowolny, M. (ESRIN, Rome). Nov 1974.

In international school of plasma physics, Varenna on Lake Como, Italy, September 27-October 9, 1971. Course on instabilities and confinement in toroidal plasmas.

A brief review is given of theoretical work on the dynamic stabilization of drift instabilities by high-frequency electric and magnetic fields, by low-amplitude ac fields, by low-amplitude ac electric fields, and stabilization in the presence of other waves. A general method is described for studying dynamic stabilization of plasma instabilities, based on an expansion on the amplitude of a given modulation of the plasma equilibrium and allowing for any frequency of modulation. (MOW)

32741 (EUR-5064e, pp 427-441) DYNAMIC AND FEEDBACK STABILIZATION OF PLASMAS. Wesson, J. (Culham Lab., Abingdon, Eng.). Nov 1974.

In international school of plasma physics, Varenna on Lake Como, Italy, September 27-October 9, 1971. Course on instabilities and confinement in toroidal plasmas.

The following topics are described: (1) dynamic stabilization, (2) generalized potential energy, (3) applications of dynamic stabilization, (4) feedback stabilization, (5) δ stabilization, (6) feedback stabilization of dissipative and reactive modes, and (7) factors affecting the required power. (MOW)

32742 (IPPJ-184) PLASMA TURBULENCE GENERATED BY ION-ION TWO-STREAM INSTABILITY. Kiwamoto, Y.; Ikezi, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Feb 1974. 34p. INIS.

Strong instability is produced by injecting a high density ion beam with a large cross-section into an unmagnetized homogeneous plasma. The linear dispersion relation of the waves in the ion-ion two-stream system is experimentally confirmed. Three-dimensional investigations of the turbulence thus produced reveal some new features: The turbulent waves propagate at large

angles to the beam with extremely short correlation length of (2-3) · wavelength. At these angles a rapid relaxation of the velocity distribution of the ions is observed until the beam temperature reaches around $T_e/5$. The energy density of the turbulence does not exceed $3 \times 10^{-3} n_n T_p$. (auth)

32743 (IPPJ-190) HYDROMAGNETIC KINK MODE OF A RELATIVISTIC ELECTRON BEAM IN A CURRENT CARRYING PLASMA. Ikuta, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1974. 18p. INIS.

The stability of the kink mode of a relativistic electron beam propagating in a current carrying plasma is analyzed. The treatments follow after Lee. It is found that the stability condition is more stringent than that of Kruskal and Shafranov. An available rotational transform ι must be $\iota/2\pi < [1 + 4\ln(d/a)]^{-1}$, where d and a are the radii of the metal wall and the beam. The relativistic effect appears in the characteristic oscillation. (auth)

32744 (IPPJ-T-18) DIRECT DIGITAL CONTROL OF A PLASMA. Ogata, A.; Matsuura, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1974. 30p. INIS.

A direct digital control, where a digital computer is utilized as a feedback element, is applied to stabilize a cusp position of a stationary plasma. The direct digital control is inferior to the conventional analog control in speed, but features infinite settling time and great flexibility. (auth)

32745 (MPI-PAE/EXTRATERR-106) DRIFT WAVE INSTABILITIES IN PLASMAS WITH SHEAR FLOW. Haerendel, G. (Max-Planck-Institut fuer Physik und Astrophysik, Garching/Muenchen (F. R. Germany). Inst. fuer Extraterrestrische Physik). Nov 1974. 37p. Dep. NTIS (US Sales Only) $5.00.

The average drift of ions in a nonuniform electric field transverse to a homogeneous magnetic field differs slightly from that of the electrons because of their larger gyroradius. In the presence of a plasma density gradient, an electric current results which is named drift shear current. This current can act in a destabilizing manner on the equilibrium plasma distribution. Several situations are evaluated for perturbations with transverse wavelengths much larger than the average ion gyroradius, but shorter than the scale of the primary nonuniformity of electric field and density. Perturbations with infinite wavelengths parallel to the magnetic field are stabilized by an inertial term due to the displacement of the ions in the direction of the zero order electric field. This result corrects an earlier conclusion of the author. Introduction of finite parallel wave-numbers leads to drift wave instabilities of different kinds depending on the choice of the dominant forces. Of particular interest is a drift dissipative instability by which a band of ionic and electronic drift waves is excited. In this case positive vorticity of the shear flow is necessary for instability. The transition from the applied local approximation to longer wavelengths, i.e., to genuine Kelvin-Helmholtz instabilities, is briefly discussed. (auth)

32746 THE STABILITY OF THE HIGH-β PLASMA IN THE TBS-FIELD ABOUT THE CUSP-AXIS. Sengoku, S.; Itoh, T.; Saito, M.; Nanri, K.; Tsuruoka, Y. (Tokai Univ., Hiratsuka, Kanagawa (Japan). Dept. of Physics). Proc. Fac. Sci. Tokai Univ.; 9: 45-56(Mar 1974).

The effective confining region of "magnetic well" was studied in a Tennis Ball Seam (TBS) coil wherein the plasma density $n \approx 10^{13}$ cm^{-3} and the electron temperatures $T_e \approx 2 \sim 7$ eV applied by ac discharge, which frequency was 91 kHz, of a condenser bank. The diffusion coefficient perpendicular to the mirror-axis was observed. And it was found that the drift wave instability for a long wave-length did not occur at the region $\nabla^2 B > 0$, also the flute like instability. It may come from increasing the value of β (β = plasma pressure/magnetic pressure). The diffusion velocity perpendicular to the mirror-axis was 10^3 cm/sec. This is one tenth as large as the ion acoustic velocity. And the decay time was fairly agreeable in order with the expected value assuming the radiative recombination losses only. (auth)

32747 HYDROMAGNETIC STABILITY OF A SELF-GRAVITATING PLASMA IN THE PRESENCE OF HALL CURRENTS. Bhatia, P. K. (Jodhpur Univ. (India)). Publ. Astron. Soc. Jap.; 26: No. 1, 109-116(Mar 1974).

The hydromagnetic stability of a self-gravitating incompressible plasma of varying density was investigated to include the effects of Hall currents. A variable horizontal magnetic field, stratified vertically, is assumed to be present in the system. A variational principle is shown to characterize the problem. Proper solutions have been obtained, by making use of the existence of the variational principle, for a semiinfinite plasma in which the density has a one-dimensional (exponential) vertical stratification. It is found that the Hall currents have a destabilizing influence. (auth)

32748 SHEAR AND WELL STABILIZATION IN A HARD-CORE THETA PINCH WITH POLOIDAL FIELD COILS. Kondoh, Y.; Okamura, S.; Hirano, K. (Gunma Univ., Kiryu (Japan). Faculty of Technology); Nagao, S. Jap. J. Appl. Phys.; 13: No. 4, 684-687(Apr 1974).

Experimental results obtained in a device having short hard-core theta pinch with poloidal field coils are described. Some instabilities, which seem to be the flute type, were observed. Those instabilities were suppressed by increasing the shear field and the magnetic well, which were produced by the hard-core and the poloidal field coils, respectively. (auth)

32749 EFFECT OF PARAMETRIC INTERACTION ON PHASE VELOCITY OF A LARGE AMPLITUDE WAVE. Nyack, C. A. (Univ. of the West Indies, Barbados, Physics Department). Phys. Lett., A; 51: No. 1, 51-52(27 Jan 1975).

The variation of the phase velocity of the unstable wave in a beam-plasma system is measured while the wave is undergoing parametric decay. The result indicates a continuous slowing down of the wave. (auth)

32750 STABILIZATION OF CONE INSTABILITY OF A COLLISIONAL PLASMA IN A MIRROR TRAP. Ioffe, M. S.; Kanayev, B. I.; Pastukhov, V. P.; Yushmanov, E. E. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 67: No. 6, 2145-2156(Dec 1974). (In Russian).

It is demonstrated experimentally that the low frequency instability of the cone type (drift-cone mode) previously observed which develops in a collisional plasma with $T_i \gg T_e$ confined in a min-B mirror trap may be stabilized by the addition of a small amount of cold ions. This can be achieved by injection of a small amount of cold plasma into the mirror or by creating such conditions in the trap which facilitate confinement of cold ions. These conditions can be attained by anisotropic overheating of part of the electrons with microwaves. (auth)

32751 STIMULATED COMBINATIONAL SCATTERING IN AN INHOMOGENEOUS PLASMA. Silin, V. P.; Starodub, A. N. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 67: No. 6, 2110-2121(Dec 1974). (In Russian).

The effect of spatial inhomogeneity of a plasma on stimulated combinational scattering due to the appearance of a satellite in the scattered transverse radiation which is caused by the Langmuir wave was studied. It is shown that such instability in the vicinity of a quarter of the critical density is absolute instability. The increase of the threshold of stimulated combinational scattering due to the effect of plasma inhomogeneity was determined. (auth)

32752 CURRENT RISE AND THERMAL INSTABILITY IN AN EXPANDING TOKAMAK DISCHARGE. Enriques, L.; Santini, F. (Laboratorio Gas Ionizzati, Frascati, Italy). Nuovo Cim.; 25B: No. 2, 842-850(11 Feb 1975).

The presence of the skin effect during the phase of current rise is a serious problem in a large Tokamak device. An analysis of the evolution of the discharge in this phase is carried out for the case where a moving limiter yields an expanding plasma column. A simple model is introduced in which heat diffusion and radiation are neglected, but where it is possible to study a class of analytical solutions which allows for a discussion of the role of different discharge parameters on the time evolution of the current and temperature profiles. It is shown that, in this somewhat pessimistic model, good profiles are obtained in a reasonably short time, provided the limiter motion is appropriate. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 32752, 33137, 33992, and 34461.

32753 (BNWL-1950(Pt.2), pp 63-66) ENVIRONMENTAL IMPACT STATEMENTS. Dec 1974.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological Sciences.

A review of information requirements pursuant to preparation of environmental impact statements for controlled thermonuclear reactor designs is presented. The objective of the effort was directed to determine the most probable type and magnitude of potential environmental impact associated with the first commercial fusion reactors. Analysis of present CTR design criteria indicated that most anticipated environmental effects to terrestrial and aquatic systems will be similar to those experienced currently by fission designs. It was concluded that suitable technology is available or would be available to provide assessment

of the importance and magnitude of such effects. However, the analysis also identified three potential sources of environmental impact unique to the CTR design, including release of kilogram quantities of tritium; release of substantial quantities of lithium; release of substantial quantities of other chemical pollutants during mining, refining, and manufacture of CTR materials; and the possibility of metal contamination resulting from deterioration of CTR materials during reactor operation. It was concluded that sufficient information is available to permit assessment of potential tritium releases, but there is insufficient data to evaluate the effects of release of large quantities of Li during an accident. (CH)

32754 (EUR-5064e) INTERNATIONAL SCHOOL OF PLASMA PHYSICS, VARENNA ON LAKE COMO, ITALY, SEPTEMBER 27–OCTOBER 9, 1971. Course on Instabilities and Confinement in Toroidal Plasmas. (Commission of the European Communities, Luxembourg). Nov 1974. 474p. Dep. NTIS (U. S. Sales Only) $26.25. EUR B. Fr. 1000.-.

A separate abstract was prepared for each of the 15 sections. (MOW)

For abstracts of individual sections see: 32676–32679, 32708, 32711–32715, 32740, 32741, and 32755–32757.

32755 (EUR-5064e, pp 11-17) INSTABILITIES AND CONFINEMENT IN TOROIDAL PLASMAS. Waelbroeck, F. (Kernforschungsanlage, Juelich, Ger.). Nov 1974.

In international school of plasma physics, Varenna on Lake Como, Italy, September 27–October 9, 1971. Course on instabilities and confinement in toroidal plasmas.

Toroidal devices are subdivided into axisymmetric and non-axisymmetric systems. The non-axisymmetric systems are mainly stellarators. Among the axisymmetric configurations, a first separation into systems with and without inner conductors was made. A table showing these divisions into levitrons, pinches, and tokamaks is given. Some of the research problems which are still to be clarified are outlined. (MOW)

32756 (EUR-5064e, pp 19-50) HIGH-BETA TOROIDAL PINCHES. Bodin, H. A. B. (Culham Lab., Abingdon, Eng.). Nov 1974.

In international school of plasma physics, Varenna on Lake Como, Italy, September 27–October 9, 1971. Course on instabilities and confinement in toroidal plasmas.

The main properties of axisymmetric pinch configurations are discussed and compared with each other and with tokamaks from the points of view of heating, equilibrium, and stability. Some general ground rules from which the stability of pinch-type systems can be assessed are given and the more important results from special cases stated. The growth of unstable modes is mentioned. (MOW)

32757 (EUR-5064e, pp 443-469) PROBLEMS WITH NUCLEAR FUSION REACTORS. Carruthers, R. (Culham Lab., Abingdon, Eng.). Nov 1974.

In international school of plasma physics, Varenna on Lake Como, Italy, September 27–October 9, 1971. Course on instabilities and confinement in toroidal plasmas.

The following three lectures are given: (1) the relationship between the plasma parameters and parameters involved in the engineering studies of a fusion reactor, (2) factors determining the size and rating of a fusion reactor, and (3) economic factors of toroidal fusion reactors. (MOW)

32758 (IPP-2/226) WEGA PARAMETER CALCULATIONS IN EQUILIBRIUM. Pacher, H. D. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Jan 1975. 79p. Dep. NTIS (U. S. Sales Only) $7.00.

Calculations of power balance in equilibrium were carried out for WEGA, taking into account profile factors and impurities. For reasonable parameters, T_e lies between 1 and 2 keV, T_i between 250 and 500 eV. The ohmic heating power lies between 50 and 100 kW. An additional input power into the plasma of 200 kW results in an increase of electron and ion temperatures by a factor 2. T_e and T_i were calculated for various n, a, I, iota, Z_{eff}, c^2, B, and heating powers. (auth)

32759 (IPP-9/18) ENERGY DISTRIBUTIONS OF CHARGED AND NEUTRAL HYDROGEN ATOMS BACKSCATTERED FROM METAL SURFACES BOMBARDED WITH 5 TO 18 keV PROTONS. Meischner, P.; Verbeek, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Muenchen (F. R. Germany)). Jan 1975. 30p. Dep. NTIS (U. S. Sales Only) $4.50.

Polycrystalline targets of Be, V, stainless steel, Mo, Nb and Ta have been bombarded with protons with primary energies in the range from 5 to 18 keV. The energy distributions of the charged and neutral particles backscattered at 135° with respect to the primary beam direction have been measured between 200 eV and 18 keV. Before measurement, the neutral particles were partly ionized in a calibrated gas stripping cell. The observed energy distribution of the neutrals has a pronounced maximum between 0.5 and 1 keV whose position does not depend within the experimental error on the primary energy, the target material, or the angle of emergence of the scattered particles. The energy distribution of the charged particles shows a less pronounced maximum between 1 and 1.5 keV for angles of emergence near the normal to the target surface. For more oblique emergence, the distribution becomes flatter and the maximum vanishes for grazing emergence. Only slight differences in the shape of the energy distributions have been observed for different target materials. The fractional number of charged backscattered particles increases from 3% at 300 eV to 40% at 18 keV. In this energy range it decreases slightly as the angle of emergence becomes more oblique. (auth)

32760 (IPPJ–188) TOKAMAK EXPERIMENT IN SPAC-II. Hamada, Y.; Mohri, A. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1974. 16p. INIS.

A small scale tokamak type device named SPAC-II was constructed for the investigation of various problems in the confinement and heating of toroidal plasmas. In a tokamak mode experiment, plasma with the electron temperature of 180 eV is generated, when the plasma current is 18 kA and the safety factor q = 3.9. The energy confinement time is about 200 μs which fits the scaling law of (plasma radius)^2 × (poloidal field). The current density is estimated to be 4×10^2 A · cm^{-2} for the parabolic distribution. (auth)

32761 (IPPJ-T-20) FAST AIR GAP CROWBAR SWITCH DECOUPLED BY A LOW PRESSURE GAP. Kitagawa, S.; Hirano, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1974. 25p. INIS.

A fast pressurized crowbar gap switch, in which a low-pressure gap is used as a non-linear decoupler, is investigated. The switch is composed of a simple two-electrode high-pressure gap and a low-pressure gap of trigatron type. A special trigger circuit is designed in order that a single pulse breaks down the high- and low-pressure gaps successively. The jitter of breakdown time is less than 20 nsec over the wide range of the operating conditions: working voltage and pressures in both gaps. The switch is designed for 40 kV operation and its inductance is 22 nH. Seventy switches of this type are installed in a 40 kV, 210 kJ fast capacitor bank. Up to now they have been running successfully for 8000 shots with little maintenance. (auth)

32762 (LA-UR-75-257) HF CHEMICAL LASERS. Jensen, R. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1974. Contract W-7405-eng-36. 20p. (CONF-750110-3). Dep. NTIS $4.00.

From Orbis scientist meeting; Coral Gables, Florida, USA (21 Jan 1975).

The proposed laser utilizes the very rapid reaction rate of $H_2 + F_2$ chain reaction coupled with the efficient formation of chain carriers by fast electron beam radiolysis of F_2 and SF_6. The laser gain is very high, but of short duration making the amplifier system much simpler than those envisioned for low gain high storage lasers. The complete oscillator–amplifier system is described. (MOW)

32763 (ORNL-TM-4853) TOKAMAK EXPERIMENTAL POWER REACTOR: BASIC CONSIDERATIONS AND INITIATION OF STUDIES AT OAK RIDGE. Haubenreich, P. N. (ed.). (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 88p. Dep. NTIS $7.50.

Scoping studies initiated at ORNL in August, 1974 are addressing basic questions, e.g., the objectives of the EPR, essential features, ranges of dimensions, research and development required to provide design input, and alternatives that must be pursued until information for firm decisions becomes available. Twelve task areas are: project definition, plasma engineering and physics, blanket and energy conversion, shielding, tritium systems, tokamak device engineering, tokamak support systems, materials and fabrication, design integration, assembly and maintenance, facility planning and project engineering, and program management. Initial results include delineation of major questions, identification of appropriate objectives and criteria, development of models and limited parametric studies of plasma characteristics, and preliminary conceptual design of an energy-recovery blanket with provisions for breeding experiments in interchangeable modules. (auth)

32764 CURRENT-CONTROLLED DC POWER SUPPLY FOR PLASMA RESEARCH. Jaysinghani, N. Brown Boveri Rev.; 61: No. 2-3, 98-104(1974).

Plasma experiments have gained importance in industry and research during the last few years. These tests are necessary for the development of switchgear, plasma burners and modern

welding equipment. Research centers face a very broad spectrum of problems in this field and therefore require power supplies which are built to special specifications with regard to stability, accuracy, harmonic content and flexibility. This contribution describes a 1.5 MW dc power supply for a research center. Through proper circuit combinations, a current range from a few amperes up to 3000 A and a voltage range of about 10 V to 6000 V can be achieved for different experiments. The system is designed for a short-term overload of 100%. The harmonic content of 1% and the current stability of 0.1% are better than the values required by the physicists. The dynamic response fulfils the stringent requirements during short circuits and operation with electric arcs with negative resistance characteristics. (auth)

32765 AMPLIFIED-SPONTANEOUS-EMISSION SUPPRESSOR FOR Q-SWITCHED LASERS. Mallozzi, P. J.; Epstein, H. M.; Applebaum, D. C.; Gallagher, W. J.; Campbell, B. E. (Battelle's Columbus Labs., OH). J. Appl. Phys.; 46: No. 3, 1410-1411(Mar 1975).

A passive device for suppressing amplified spontaneous emission in Q-switched lasers was developed. The technique is applicable to lasers of any aperature. (auth)

32766 FORESEEABLE THERMAL, MECHANICAL, AND MATERIALS ENGINEERING PROBLEMS OF FUSION REACTOR POWER PLANTS. Fraas, A. P. (Oak Ridge National Lab., Tenn. (USA)). Nucl. Eng. Des.; 29: No. 3, 295-310(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The engineering problems that will be posed by full-scale fusion reactor power plants are illustrated by examining a representative conceptual design. The temperature extremes that must be accommodated run from 4°K in superconducting magnets to 10^{8}°K in the plasma. These temperature differences lead to difficult problems with differential thermal expansion, high heat fluxes, and stringent thermal insulation requirements. The magnetic fields that must be provided run from 25 to 100 kG, and these fields induce forces on elements of the structure of the order of 20,000 tons. The walls of the chamber containing the plasma must withstand intense radiation by 14 MeV neutrons and 1 to 50 keV ions. Unusual fluid flow and heat transfer problems include two-phase boiling flow of helium in the superconducting magnets, and the magnetohydrodynamic effects on the flows of red hot lithium and boiling potassium in a high magnetic field. These and many other problems must be solved in such a way as to give a reliable, safe system at a reasonable capital cost, and this must be done with materials whose nuclear, physical, and fabrication properties and resistance to corrosion meet all of the requisite boundary conditions. (auth)

32767 APPLICATION FOR MHD POWER GENERATION AND NUCLEAR FUSION POWER GENERATION. Aiyama, Y. (Electrotechnical Lab., Tokyo (Japan)). Denki Gakkai Zasshi; 94: No. 5, 408-411(May 1974). (In Japanese).

This paper reviews the application of superconductivity for MHD power generation and fusion power generation. Superconducting magnets are required to obtain high magnetic flux. The outline of a superconducting magnet for a 500 MW MHD generator is shown in a table. The inner diameter of coil is 5.0 m and the outer diameter is 5.6 m. The flux density at center is 5.1 T. The central magnetic flux density B_0 and the maximum flux density B_M of a toroidal coil for a fusion reactor were calculated. The material of coils for MHD power generation must be available for the magnetic field of 7 ~ 9 T, and Nb-Ti alloy can meet this requirement. However, material for fusion reactor must be developed, because higher magnetic field should be produced. The material for electric wires is another subject of study. The precise calculation for coil design is required since the maximum field to be applied to coil wires is different from central magnetic field. When coils become large, the electromagnetic force acting on the coils is also large, and mechanical consideration is necessary. Cooling of coils is also an important problem for superconducting magnets. (auth)

32768 PERMEATION OF THE VERTICAL MAGNETIC FIELD THROUGH THE THIN SHELL IN A TOKAMAK. Sugawara, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Jap. J. Appl. Phys.; 13: No. 4, 693-696(Apr 1974).

Effects of the resistivity and the transverse cuts of a shell on the equilibrium position of a plasma column in a Tokamak is considered. The equations for the permeation of the vertical component of the magnetic field due to the shifted current with respect to the shell and the leakage field from the iron core of a transformer through the shell are derived with the approximation of a thin shell and a short gap. Comparison with the model experiment using a current-carrying conductor in the 1/3 device of JFT-2 apparatus is satisfactory. A formula for the displacement of the plasma is also shown. (auth)

32769 LASER FUSION MOVES BOLDLY INTO LIMELIGHT. Freiwald, D. A.; Frank, T. G. (Los Alamos Scientific Lab., NM). Elec. World; 138: No. 1, 34-37(1 Jan 1975).

Basic concepts of thermonuclear fusion are reviewed. A possible power plant utilizing laser-produced microexplosions is described. An energy mass and flow schematic for a conceptualized laser-fusion power plant is given. The environmental impact of a fusion reactor is also discussed. (MOW)

32770 LASER-INDUCED THERMONUCLEAR MICRO-EXPLOSIONS USING FISSIONABLE TRIGGERS. Seifritz, W.; Ligou, J. (Swiss Federal Inst. for Reactor Research, Wuerenlingen, Switzerland). Nucl. Sci. Eng.; 56: No. 3, 301-303(Mar 1975).

Energy may possibly be released in purely fissionable materials or in mixtures of fission/fusion materials following irradiation to produce compression and heating leading to micro-explosions. This is a variation of the "laser-fusion" concept. A design of a pellet is presented that consists of a fissionable trigger-and a mantle of fusionable material. Sophisticated neutronics and burnup calculations for the fission trigger show that such a device possesses a substantially higher "gain" than a purely fusionable pellet. This may open a new outlook for the peaceful utilization of nuclear energy through a breeder reactor system with an extremely short fuel doubling time and with the possibility of directly converting the released energy into electricity. Furthermore, the fission trigger may be used to kindle not only DT and LiD mantles but also DD and probably p-^{11}B mantles to full thermonuclear ignition. (auth)

Wave Phenomena

Refer also to abstracts 32687 and 34403.

32771 (AD-785618) SIMULATION OF A SIMPLE LORENTZ PLASMA WITH A RANDOM DISTRIBUTION OF INDUCTIVELY-LOADED DIPOLES. Dietz, J. F. W.; Merkel, G. (Harry Diamond Labs., Washington, D. C. (USA)). 1973. 16p. NTIS $3.25.

The complete simulation of the electromagnetic pulse, EMP, associated with a nuclear burst involves a number of interrelated parameters. The most obvious parameters are the waveform and the magnitude of EMP. However, if the system being subjected to the nuclear EMP is in a preionized region such as the ionosphere, it would also be necessary to simulate the ionization or dielectric constant of the medium surrounding the system such as a missile or satellite. The feasibility of using an artificial dielectric consisting of a random distribution of inductively-loaded short dipoles to simulate the macroscopic electromagnetic properties of a simple Lorentz plasma was studied. (auth)

32772 (AD/A-000368) REFLECTION OF ELECTROMAGNETIC WAVES WITH OBLIQUE INCIDENCE ON A MOVING IONIZATION FRONT. Semenov, V. I. Translated by R. D. Hill from Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 15: No. 5, 665-674(1972). 22p. (FTD-MT-24-1550-74). NTIS $3.25.

The oblique incidence of monochromatic Te- and Tm-waves onto a sharp boundary of the plasma formed by the source of ionization moving at a constant velocity is examined. Equations for the coefficients of reflection and passage are obtained and investigated. A feature of the case of tm-waves is the excitation in the plasma behind the front of longitudinal oscillations at any frequency of the incident transverse wave. (GRA)

32773 (IPPJ-194) NONLINEAR SKIN EFFECT OF HIGH-POWER MICROWAVE INCIDENT ON A COLLISIONLESS MAGNETIZED PLASMA. Minami, K.; Singh, K. P.; Masuda, M.; Ishii, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Aug 1974. 31p. INIS.

Experimental results are presented which verify a nonlinear skin effect of high-power microwaves incident on a collisionless, uniform plasma having a sharp boundary. The skin depth, observed by microwave reflection techniques, increases with the incident microwave power. The results are compared with the theoretical analysis in which the radiation pressure due to electromagnetic field is taken into account. (auth)

32774 (N-74-27228) INVESTIGATION OF THE TRANSMISSION OF A POWERFUL LASER BEAM THROUGH AN OPTICALLY DENSE PLASMA. Burakov, V. S.; Naumenkov, P. A. Translated from Zh. Prikl. Spektrosk.; 16: No. 2, 239-242(1972). 9p. (NTC-74-11950). NTIS $4.00.

The transmission of ruby laser emission (density 1 million to 5×10^{9} W/cm^2, duration 3×10^{-8} s) through a quasi-stationary plasma with a temperature of 3 to 4 eV and a comparatively high

absorption coefficient (4 to 7/cm) was investigated. The mechanism of the observable illumination of the plasma is discussed. (auth)

32775 (N-74-27230) VARIATIONAL CALCULATIONS FOR RESONANCE OSCILLATIONS OF INHOMOGENEOUS PLASMAS. Peng, Y. K. M.; Crawford, F. W. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Nov 1973. 40p. (NASA-CR-138648; SU-SUIPR-548). NTIS $5.00.

The electrostatic resonance properties of an inhomogeneous plasma column are reported by application of the Rayleigh-Ritz method. A description of the rf equation of motion and pressure term that expresses the system of equations in Euler-Lagrange form is presented. The Rayleigh-Ritz procedure is applied to the corresponding Lagrangian to obtain approximate resonance frequencies and eigenfunctions. An appropriate set of trial coordinate functions is defined, which leads to frequency and eigenfunction estimates. (auth)

32776 (N-74-27231) MACROSCOPIC PLASMA LAGRANGIAN AND ITS APPLICATION TO WAVE INTERACTIONS AND RESONANCES. Peng, Y. K. M. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Jun 1974. 262p. (NASA-CR-138649; SU-SUIPR-575). NTIS $16.25.

The derivation of a macroscopic plasma Lagrangian is considered, along with its application to the description of nonlinear three-wave interaction in a homogeneous plasma and linear resonance oscillations in a inhomogeneous plasma. One approach to obtain the Lagrangian is via the inverse problem of the calculus of variations for arbitrary first and second order quasilinear partial differential systems. Necessary and sufficient conditions for the given equations to be Euler-Lagrange equations of a Lagrangian are obtained. These conditions are then used to determine the transformations that convert some classes of non-Euler-Lagrange equations to Euler-Lagrange equation form. The Lagrangians for a linear resistive transmission line and a linear warm collisional plasma are derived as examples. Using energy considerations, the correct macroscopic plasma Lagrangian is shown to differ from the velocity-integrated low Lagrangian by a macroscopic potential energy that equals twice the particle thermal kinetic energy plus the energy lost by heat conduction. (auth)

32777 PROPAGATION OF COMPRESSIONAL ALFVEN WAVES IN NONUNIFORM PLASMAS. Morrow, R. (Flinders Univ. of South Australia, Bedford Park); Brennan, M. H. Aust. J. Phys.; 27: No. 2, 181-194(Apr 1974).

A theoretical treatment is presented for the propagation of Alfven waves in a plasma. It includes the effects of resistivity, ion-neutral collisions, the ion cyclotron frequency and radial nonuniformities in ion density, neutral particle density and temperature. The theory is applied to plasmas with conducting and nonconducting walls and the results are compared with those of experiments conducted in the afterglow of a shock-produced plasma. Nonuniformity in the ion density is found to have a marked effect on the dispersion relation and wave field profiles, while nonuniformities in the total particle density and temperature are less important. Excellent agreement is obtained between theory and experiment and this allows unambiguous and accurate determinations to be made of the average total particle density, which is found to be ~50% of the initial filling density, and of the cross section for momentum transfer between protons and hydrogen atoms. (auth)

32778 EQUATIONS OF SLOW ELECTROMAGNETIC PHENOMENA IN HIGHLY MAGNETIZED PLASMA. Krylov, A. L. (Inst. of Earth Physics, Moscow). Dokl. Akad. Nauk SSSR; 218: No. 5, 1056-1059(11 Oct 1974). (In Russian).

Equations are derived of the boundary conditions for slow electromagnetic phenomena in highly magnetized plasma. (JSR)

32779 NONLINEAR WAVE INTERACTIONS IN TURBULENT PLASMAS. Tsytovich, V. N. (Inst. of Physics, Moscow); Stenflo, L. Phys. Scr.; 10: No. 4, 194-196(Oct 1974).

Within nonlinear theory, it is often found that exact decay processes are forbidden in the first order of approximation. In the presence of turbulence it is however possible that frequency shifts and turbulent collisional effects are responsible for additional small contributions to the matrix elements and that these extra terms can be comparable in magnitude to the sum of other contributions which might have cancelled each other. A general theory and results for a magnetized plasma are developed. An interesting example concerning whistler wave propagation is also given. (auth)

32780 NONLINEAR PHENOMENA IN PLASMA, 1. Sanuki, H. (Nihon Univ., Tokyo. Dept. of Physics). No. 2, 49-79(Jun 1973). (In Japanese).

Recent problems of the nonlinear phenomena in plasma are investigated systematically. This paper is composed of six parts. First of all, the effects of turbulent fluctuations on the plasma wave echo are investigated for one-dimensional weakly turbulent electron plasma. This phenomena is noted in view of the nonlinear response in plasma. Secondly, one-dimensional stationary nonlinear electrostatic waves, namely, B-G-K waves are examined by the perturbation method based on a canonical transformation. Thirdly, a generalized Korteweg-deVries type equation is obtained for small but finite amplitude waves in plasma by treating the Vlasov equation perturbation theoretically. The influence of Landau damping on the ion sound soliton and its stability are discussed in a two temperature plasma with $T_i \ll T_e$. Fourthly, it is shown that the behavior of the wave amplitude is governed by the generalized nonlinear Schroedinger equation. On the basis of this equation, the decay process and stability of the nonlinear waves are investigated for the ion wave and the electron plasma wave. Fifthly, it is found that the oscillating solution of the Korteweg-de Vries equation agrees with the solution of the nonlinear Schroedinger equation in the small wave number region. Furthermore the problem of modulational instability is discussed. Finally, it is shown that using the quasi-monochromatic approximation and time separation procedure, the Korteweg-de Vries equation is derived from the Vlasov-Poisson equations. In addition, the relation between two methods, the reductive perturbation method and the weak turbulence formalism, which were developed to treat quite different physical situations, are discussed. (auth)

32781 ONE SOLUTION OF KOSHI PROBLEM FOR NONLINEAR PLASMA OSCILLATIONS. Berman, G. P. (Inst. of Physics, Krasnoyarsk, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 11, 1599-1604(1974). (In Russian).

An example of the exact solution for the Koshi problem of the development of the initial profile of nonlinear plasma oscillations under periodic initial conditions is considered. The solution is written in Eulerian variables. The tipover conditions are obtained for the electron motion with different phase and scales of space periods. (auth)

32782 STIMULATED COMPTON SCATTERING IN A PLASMA IN MAGNETIC FIELD. Spatschek, K. H.; Shukla, P. K.; Yu, M. Y. (Univ., Bochum, Ger.). Lett. Nuovo Cim.; 12: No. 10, 368-370 (8 Mar 1975).

Stimulated compton scattering instabilities magnetized plasmas, such as the ionosphere and some laboratory plasmas, as well as laser fusion plasmas where magnetic fields are spontaneously generated. The case is considered in which the pump and the scattered electromagnetic waves are circularly polarized and propagating parallel to the magnetic field. Here, stimulated Compton scattering instabilities can occur when the phase velocity of the low frequency electrostatic perturbations is of the order of the electron or ion thermal velocities. (MOW)

32783 ELECTROMAGNETIC WAVE SURFACE IN AN ELECTRICALLY ANISOTROPIC PLASMA. Agostinelli, C. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur.; 54: No. 4, 597-603(Apr 1973). (In Italian).

The propagation of electromagnetic waves in a very rarefied plasma is considered on the assumption that the magnetic field determines an electric anisotropy and the dielectric power is a tensor with parallel and perpendicular components to the magnetic field. The differential equation of the wave surface and the equation that define the velocity of propagation are given. The case in which the magnetic field is tangent to the wave surface is considered. In this case, the velocity of propagation of the wave front is dependent on the normal component to the wave surface of the Poynting vector. Another interesting case is that in which the parallel component to the magnetic field of the electric field, and the perpendicular component, have the same projection on the normal to the wave surface. (auth)

32784 ELECTRON PLASMA RELAXATION PROCESSES. Hino, T.; Ozawa, Y. (Hokkaido Univ., Sapporo (Japan). Faculty of Engineering). J. Nucl. Sci. Technol. (Tokyo); 11: No. 5, 169-171(May 1974).

The solution of the Vlasov equation for the longitudinal electron plasma wave is obtained by using Neumann series method. The electron relaxation process is analytically described by the superposition of expressions for electron streamings and Coulomb collisions. The currently established formula for the longitudinal plasma wave is also explained by the closed-form solution of the Vlasov equation. The expression effectively describes the detailed physical processes of the electron plasma wave relaxation both in space and time. (auth)

32785 COLLISIONLESS PLASMA OSCILLATIONS, THEIR RESIDUAL PRESENTATION AND THE MECHANISM OF LANDAU DAMPING. Ecker, G.; Froemling, G. (Bochum Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Z. Naturforsch., a; 29: No. 12, 1863-1873(Dec 1974).

The description of the electron oscillations of a collisionless plasma by the usual residual presentation is insufficient in the initial phase of time development and for perturbations of small velocity spread. Criteria are derived for the number of residual terms which have to be taken into account and analytic expressions are obtained for the remaining integral. By decomposition of the initial perturbation into velocity beams, it is shown that Landau damping is due to phase mixing caused by free streaming of particle beams modified through the response of the main plasma body. (GE)

32786 DYNAMIC STABILIZATION OF COLLISIONAL DRIFT WAVES IN A R. F. PLASMA. van Andel, H. W. H.; Mah, S. Q.; Teichmann, J. (Montreal Univ., Quebec (Canada). Dept. of Physics). Phys. Lett., A; 50: No. 6, 403-404(13 Jan 1975).

Dynamic stabilization of collisional drift modes in a c.w. R.F. plasma was demonstrated using a localized oscillating magnetic field. (auth)

32787 PROPAGATION OF SOLITARY ION ACOUSTIC WAVES IN INHOMOGENEOUS PLASMAS. Nishikawa, K.; Kaw, P. K. (California Univ., Los Angeles (USA). Dept. of Physics). Phys. Lett., A; 50: No. 6, 455-456(13 Jan 1975).

A WKB solution for the propagation of a solitary ion acoustic wave in a plasma with a density gradient is obtained. (auth)

32788 STIMULATED SCATTERING OF LASER RADIATION IN A PLASMA. Burunov, E. A.; Malyshev, G. M.; Razdobarin, G. T.; Semenov, V. V.; Folomkin, I. P. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz.; 68: No. 1, 111-114 (Jan 1975). (In Russian).

An increase of scattering over that due to thermal fluctuations is observed in a laser radiation plasma. The scattering increase is observed if the threshold condition for excitation of parametric instability in the plasma by electromagnetic radiation is satisfied. (auth)

32789 TWO EXAMPLES OF COLLAPSE OF LANGMUIR WAVES. Degtyarev, L. M.; Zakharov, V. E.; Rudakov, L. I. (Inst. of Applied Mathematics, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 1, 115-126(Jan 1975). (In Russian).

The evolution of two types of initial plasma density distributions and of the amplitude of Langmuir oscillations in the plasma was studied numerically and analytically. In the first case, movement toward the center of a one-dimensional spherical soliton is considered and in the second, the nonlinear stage of instability for a two-dimensional plane soliton is considered. Cases of both small and large Langmuir wave amplitudes are considered. The principle possibility of collapse of Langmuir waves, i.e., the concentration of plasma oscillations in regions of low plasma density is proved. (auth)

32790 FORMATION OF A NONLINEAR HIGH AMPLITUDE WAVE IN THE DEVELOPMENT OF TWO-BEAM INSTABILITY OF AN ION-ION PLASMA. Kozyrev, Yu. N.; Naida, A. P. (Inst. of Physics, Kiev). Zh. Eksp. Teor. Fiz.; 67: No. 6, 2104-2109(Dec 1974). (In Russian).

The time variation of the electric field and potential of a wave excited during the development of a plasma consisting of positive and negative ions and also the ion velocity distribution functions are investigated experimentally. It is shown that the evolution of a weak initial perturbation of sinusoidal shape leads to the formation of a nonlinear wave resembling spikes of high amplitude electric field pulses; furthermore, the wave involves the capture of a certain amount of particles of both signs and the formation of captured particle clusters or macroparticles. (auth)

32791 SOLITARY CHARGE DENSITY WAVES IN A MAGNETOACTIVE PLASMA. Krivoruchko, S. M.; Fainberg, Ya. B.; Shapiro, V. D.; Shevchenko, V. I. (Physical-Technical Inst., Kiev). Zh. Eksp. Teor. Fiz.; 67: No. 6, 2092-2103(Dec 1974). (In Russian).

It is shown that a charge density wave moving obliquely to a magnetic field may have the shape of a solitary electron bunch (charge density soliton). The dispersion characteristics of the soliton, adiabatic soliton damping due to interaction with resonant particles and soliton amplification by an electron beam are studied theoretically and experimentally. (auth)

32792 LONG-RANGE PART OF A LOCALIZED LANGMUIR PERTURBATION IN AN ELECTRON PLASMA. Ryutova, M. P. (Inst. of Nuclear Physics, Novosibirsk, USSR). Zh. Eksp. Teor. Fiz.; 67: No. 6, 2161-2166(Dec 1974). (In Russian).

It is demonstrated that a static electric field arises near a localized Langmuir perturbation and that the strength of the field decreases only in accordance with a power law ($E \sim 1/x^2$) with increase of distance from the perturbation region. The region in which the field exists is of the order of L^2/r_D, where L is the dimension of the Langmuir perturbation and r_D is the Debye radius. (auth)

32793 ELECTROMAGNETIC WAVE SCATTERING FROM A TURBULENT PLASMA. Martens, C. P. (Hong Kong Polytechnic, Kowloon); Jen, N. C. Radio Sci.; 10: No. 2, 221-228(Feb 1975).

The Doppler spectrum of electromagnetic radiation scattered by a turbulent plasma is calculated for the case in which the incident wave is a high frequency microwave or a laser beam and is not of sufficient intensity to heat the plasma. The differential scattering cross section is expressed in terms of the power spectrum of the current density fluctuations, and the wave equation and the equations of continuity and momentum for the electrons are analyzed by means of the repeated cascade theory of turbulence. The equation governing the current density spectrum in the universal equilibrium range consists of three terms: a term representing the excitation of the spectrum near the wave number of the incident wave, a term which transfers energy across the spectrum at a rate controlled by an eddy viscosity, and a molecular dissipation term. Solutions for the spectrum are obtained in the inertial and dissipation subranges which reduce to Kolmogorov and Heisenberg type spectra, respectively, in the limits of zero scattering or for wave numbers far from the wave number of the incident wave. Near the frequency ω_0 of the incident wave, the differential cross sections, or equivalently Doppler spectra, for scattering at frequency ω vary exponentially as $-\Delta\omega^{-5}$ in the inertial subrange and as $-\Delta\omega^{3}$ in the dissipation subrange, where $\Delta\omega = \omega - \omega_0$. The characteristic frequencies controlling the Doppler half widths depend upon the scattering angle, the intensity of the incident wave, and the root-mean-square electron density fluctuation. (auth)

32794 COLLISIONAL DAMPING OF ELECTROMAGNETIC WAVES IN PLASMA. Singh, S. (Government Higher Secondary School, Tanda, India); Gupta, S. C.; Midha, J. M. Indian J. Pure Appl. Phys.; 12: No. 11, 786-788(Nov 1974).

Using a conductivity tensor expression which takes collisional contribution from Landau collision integral, the structure of the spatial collision damping of electromagnetic waves propagating through a dense, hot, and fully-ionized collisional magnetoplasma, is made in terms of the plasma parameters. This has been done for the wave propagation perpendicular to the applied magnetic field B_0 and the polarization of the wave along B_0. Also the variation of the damping with the plasma parameters is studied theoretically, and the results are compared with those obtained from using conductivity tensors based on BGK collision model. (auth)

32795 NARROWING AND DIVERGENCE OF A RADIATION BEAM IN INDUCED COMPTON SCATTERING. Gol'din, V. Ya.; Syunyaev, R. A.; Chetverushkin, B. N. (Inst. of Applied Mathematics, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 1, 36-43(Jan 1975). (In Russian).

Induced Compton scattering by plasma electrons leads to narrowing or expansion of the radiation beam depending on the spectrum. Angular effects become apparent earlier than spectral effects. Results of numerical calculations of evolution of the angular distribution and of the spectrum of the radiation beam interacting with a low density plasma are presented. The possibility of partial turning of the radiation beam by another beam is considered. The effect under consideration may lead to anisotropy of low-frequency radiation from astronomical objects. (auth)

32796 GENERATION OF HARMONICS ON SCATTERING OF AN INTENSE ELECTROMAGNETIC WAVE BY SURFACE OSCILLATION FLUCTUATIONS. Aliev, Yu. M.; Vukovich, S.; Gradov, O. M.; Kirii, A. Yu. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 1, 85-94(Jan 1975). (In Russian).

The spectral correlation function for an electromagnetic field of surface oscillations in a stable plasma irradiated by an intense electromagnetic wave is obtained without assuming smallness of intensity of the incident wave. The presence of an intense field leads to appreciable alteration of the correlation spectrum and to the appearance of frequency harmonics of the external wave which are shifted by the proper frequencies of the surface oscillations. The harmonic fields with small numbers are localized near the plasma boundary. The spectral radiation fluxes from the plasma are found for fields corresponding to sufficiently large numbers of the frequency harmonics of the incident wave. (auth)

32797 CUTOFF OF CIRCULARLY POLARIZED ELECTROMAGNETIC WAVES IN A WAVEGUIDE FILLED WITH AXIALLY MAGNETIZED PLASMA. Musil, J.; Zacek, F.; Zakrzewski, Z. (Inst. of Plasma Physics, Prague). Czech. J. Phys.; B25: No. 2, 155-158(1975).

An experimental investigation of the cutoff conditions for RHCP and LHCP waves propagating in an axially magnetized plasma filling a circular waveguide is described. The results of an experiment carried out in the X-band are in a qualitative agreement with the linear theory. (auth)

32798 DIPOLE CHARACTER OF THE COLLAPSE OF LANGMUIR WAVES. Degtyarev, L. M.; Zakharov, V. E. (Inst. of Applied Mathematics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 20: No. 6, 164-166(20 Sep 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 20: No. 6, 365-370(20 Sep 1974).

Langmuir collapse is an important mechanism of energy transfer from Langmuir waves to plasma particles; a study of the structure of the plasma cavern produced in the collapse is of great interest. It was reported earlier that in a number of cases it is possible to have a collapse that has no spherical or (in the planar case) axial symmetry. The result of the present paper is the establishment of the fact that the principal role in the collapse is played by caverns that compress in self-similar fashion, inside of which the distribution of the oscillating electric charge has the character of a dipole elongated in a plane perpendicular to the dipole moment. (MOW)

ENGINEERING

Energy Conversion

Refer also to abstracts 33717 and 34047.

32799 (AD/A-001210) RADIOISOTOPE SOURCES OF ELECTRIC POWER. Fradkin, G. M.; Kodyukov, V. M. 20 Sep 1973. Translation by B. Kingsley and V. Vaguine of Radioizotopnye Istochniki Elektricheskoi Engerii, Moscow, 1972. (FSTC-HT-23-1503-73). 82p. NTIS $4.75.

The basic principles of operation of radioisotope current sources for various purposes are summarized. Structural diagrams of contemporary radioisotope thermoelectric generators are surveyed. Methods of obtaining radioisotope sources of thermal energy are described and their physical and radiation characteristics given. Problems of radiation safety during work with radioisotope thermoelectric generators are reviewed. (GRA)

32800 (JPRS-63259) OPERATIONS WITH THE "BETA-S" AND "PINGVIN" THERMOELECTRIC ISOTOPE GENERATORS IN THE ANTARCTIC. Kharin, E. P. Translated from Inform. Byull. Sov. Antarkt. Eksped.; No. 88, 62-67(1974). 10p. NTIS $3.25.

32801 (MND-2062-06-7) SNAP 29: POWER SUPPLY SYSTEM. Third Quarterly Progress Report. (Martin Marietta Corp., Baltimore, Md. (USA)). Aug 1967. Contract AT(29-2)-2062. 306p. Dep. NTIS $18.50.

Declassified 30 Aug 1973.

Research progress on the development of SNAP 29 is reported. SNAP 29, a radioisotope thermoelectric generator system, is designed to produce a nominal electrical power output of 500 W for 90 days after launch with ^{210}Po, at an overall weight of 500 lb or less. (TFD)

32802 (MND-P-2775-2) SNAP 9A RADIOISOTOPE-FUELED GENERATOR. Final Safety Analysis for Transit Mission. Dobry, T. J. (Martin Marietta Corp., Baltimore, Md. (USA)). Mar 1963. Contract AT(30-1)-2871. 244p. Dep. NTIS $15.25.

Declassified 6 Sep 1973.

The operational safety of a plutonium-fueled SNAP 9A thermoelectric generator for use as an electrical power supply in the Transit 5 BN terrestrial navigation satellite is evaluated. This satellite will provide accurate, all-weather navigation information for aircraft and ships at sea. The safety of the device is evaluated against criteria intended to ensure the design of hardware safe for handling, launching and orbital re-entry. At various times during these operations, the generator could conceivably be exposed to environments of such severity that the containers of the radioactive fuel might be impaired. The purpose of the studies and tests conducted was to analyze the environmental history of the generator, determine the conditions which tend to make fuel release possible, and to define the radiological hazards associated with such releases as are permitted to occur. A rigorous test program was conducted in an effort to substantiate much of the theoretical safety analysis. Detailed test descriptions, data and results of the tests are included. (auth)

32803 (NYO-3584-1) COMPACT THERMOELECTRIC CONVERTER. Final Progress Report, June 28-December 31, 1965. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Jan 1966. Contract AT(30-1)-3584. 410p. (WANL-PR(CC)-006). Dep. NTIS $23.50.

Declassified 31 Aug 1973.

Progress during the period from June 28 to Dec. 31, 1965 in the development of tubular thermoelectric modules for a compact high-performance spacecraft power system thermoelectric generator using either radioisotope or SNAP reactor heat sources is reported. (LCL)

32804 (NYO-3584-2) COMPACT THERMOELECTRIC CONVERTER. Phase II-A. Quarterly Progress Report, January 1-March 31, 1966. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Apr 1966. Contract AT(30-1)-3584. 123p. (WANL-PR(CC)-009). Dep. NTIS $9.25.

Declassified 6 Sep 1973.

Progress during the period from January to April 1966 in the development of tubular thermoelectric modules for a compact high-performance spacecraft power system thermoelectric generator using either radioisotope or SNAP reactor heat sources is reported. Of the 17 modules worked with during this period, 3 were in continuing tests, destructive examination was completed on 3 and in process for 1, 4 were being assembled, parts for 3 were being fabricated, and the design of 3 modules was completed. (LCL)

32805 (NYO-3584-3) COMPACT THERMOELECTRIC CONVERTER. Phase II-A. Quarterly Progress Report, April 1-June 30, 1966. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Jul 1966. Contract AT(30-1)-3584. 144p. (WANL-PR(CC)-012). Dep. NTIS $10.25.

Declassified 6 Sep 1973.

Progress during the period from April to July 1966 in the development of tubular thermoelectric modules for a compact high-performance spacecraft power system thermoelectric generator using either radioisotope or SNAP reactor heat sources is reported. Of the 17 modules worked with during this period 9 were undergoing continuing performance tests, destructive examination was underway on 3 units and completed on 4 more, and one unit awaited testing. (LCL)

32806 (NYO-3584-4) COMPACT THERMOELECTRIC CONVERTER. Phase II-A. Quarterly Progress Report, July 1-September 30, 1966. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Oct 1966. Contract AT(30-1)-3584. 140p. (WANL-PR(CC)-015). Dep. NTIS $10.00.

Declassified 6 Sep 1973.

Progress during the period from July to October 1966 in the development of tubular thermoelectric modules for a compact high-performance spacecraft power system thermoelectric generator using either radioisotope or SNAP reactor heat sources is reported. Of the 24 modules used during this period, performance testing continued on 14, destructive examination was in progress or completed on 6, 1 unit was held in inactive status, 1 was shipped to JPL, and 2 were being held due to leakage problems. (LCL)

32807 (NYO-3584-10) COMPACT THERMOELECTRIC CONVERTER. Phase II-B. Quarterly Progress Report, January 1-March 31, 1968. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Apr 1968. Contract AT(30-1)-3584. 116p. (WANL-PR(CC)-033). Dep. NTIS $9.00.

Declassified 6 Sep 1973.

Performance information is presented for twenty-four tubular thermoelectric modules tested during the period from Jan. to April 1968. The first module fabricated has accumulated over 21,000 hours of successful operation under matched load conditions. Methods of reducing degradation are discussed. Data from TEM-9U and TEM-9AC series modules, using tungsten foil barriers and molybdenum inner conductor rings to prevent TEGS-2P degradation, continue to exhibit effective operation. High temperature data from modules employing TEGS-3P material indicate that, within experimental accuracy, there is no increase in degradation rate as hot clad temperatures are increased. These data include peak temperatures as high as 1370°F. The TEM-9S series of modules are discussed and evaluation of the data from S/N-1 indicates a reduction of nearly 50 percent in end closure heat losses. The TEM-9T thin mica module is discussed and the data presented show that it had the highest beginning-of-life circuit efficiency of any module tested at standard operating conditions. A new series of modules, TEM-10, was designed and fabricated. The new module has an I.D. of approximately 1 in and an O.D. of approximately 2½ in. This module is a high efficiency design, which is suitable for heat pipe application to supply module heating, and demonstrates a marked advance in tubular module technology. (auth)

32808 (WANL-TMI-1808) PERFORMANCE EVALUATION OF SILICON-GERMANIUM-LEAD-TELLURIDE CASCADED TUBULAR THERMOELECTRIC MODULES. VanBibber, L. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 Aug 1967. 29p. Dep. NTIS $4.50.

Performance of a thermally in-series electrically separated silicon-germanium-lead-telluride tubular module is presented for a range of compatible SiGe and PbTe stage dimensions. Insulator, conductor, and cladding materials now used in the PbTe tubular modules were also used in the SiGe stage for the purpose of evaluating potential performance gains which might be obtainable. Much materials development work, not considered in this study, is needed to solve the material problems associated with the SiGe stage. The additional complexity of a series electrical circuit was also avoided to make this first study more compact. Designing a series electrical circuit could only negligibly improve the performance reported if matching the electrical resistances of the SiGe and PbTe couples is not a problem. If, however, mismatches in couple resistances exist, considerable efficiency losses could result. Losses due to possible electrical mismatches were not fully evaluated in this study; however, for

one geometry a 5 to 10% reduction in power output was noted for a 1400 to 1800°F hot clad temperature range. Starting with a PbTe tubular module having approximately 6.4% module circuit efficiency with T_H (hot clad temperature) = 1100°F, this study shows that this efficiency could be increased with a high temperature SiGe stage to 7.8% if T_H = 1500°F and to 9.2% if T_H = 1800°F. (auth)

Facilities and Equipment

Refer also to abstracts 33028 and 35601.

32809 (AGC-2711(Vol.3)(Bk.1)(Pt.1)) E-MAD AND SUPPORT FACILITIES COMPLEX OPERATIONS DATA BOOK. Volume III. Book 1. Part 1. (Aerojet-General Corp., Azusa, Calif. (USA)). 1 Feb 1964. 309p. Dep. NTIS $18.50.

Preliminary data for the E-MAD and Support Facilities Complex are presented. The report is published for review and comment by those connected with the activation and operation of this complex. (auth)

32810 (AGC-2711(Vol.3)(Bk.1)(Pt.2)) E-MAD AND SUPPORT FACILITIES COMPLEX OPERATIONS DATA BOOK. Volume III. Book 1. Part 2. (Aerojet-General Corp., Azusa, Calif. (USA)). 1 Feb 1964. 226p. Dep. NTIS $14.50.

Preliminary data for the E-MAD and Support Facilities Complex are presented. The report is published for review and comment by those connected with the activation and operation of this complex. (auth)

32811 (CEA-CONF-2735) SODIUM LOOP "AGATHE." Perret, F.; Hayet, L. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). [nd]. 20p. (In French). (CONF-740990-1). Dep. NTIS (US Sales Only) $4.00.

From 16th committee meeting of Euratom hot laboratories; Winfrith, UK (18 Sep 1974).

In order to study the results of the entry of liquid Na into a ruptured fuel element and to determine the migration of fission products from a fuel rupture, the sodium loop "Agathe" was constructed. The design, construction, and operation of the loop are described in detail. The controls that can be achieved during operation are discussed. The difficulties which the high temperature cause are briefly considered. (JSR)

32812 (HEDL-TME-74-63) HEDL SODIUM REMOVAL PROGRAM, ANNUAL REPORT FY-1974. Ballif, J. L.; Barton, G. B.; Borisch, R. R.; Caplinger, W. H.; Funk, C. W.; Lutton, J. M.; Maffei, H. P. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jan 1975. Contract AT(45-1)-2170. 43p. AT.

The sodium removal program at HEDL has demonstrated the ability of the water-vapor/nitrogen process to clean pumps, heat exchangers and valves. The feasibility of the process was demonstrated and operating conditions for reacting both bulk sodium and sodium in crevices without damaging the components were identified. Process development included the definition of processing rates for removing bulk and crevice sodium to establish processing cycles and processing facilities design. It was concluded that the water vapor in nitrogen reacts with bulk sodium at a rate of 0.02 in.-Na/h. Also, crevices must be larger than 0.001 in. to be effectively and reproducibly processed to remove sodium. Therefore, components with crevices smaller than 0.001 in. and/or shrink-fit interfaces should be disassembled to assure the complete removal of sodium, thus avoiding caustic formation and possible cracking. Heat transfer codes for predicting component thermal distribution were validated by using a thermal balance of heat of reaction with the rate of heat dissipation. Conditions leading to caustic cracking of type 304 SS were found to require exposure to sodium hydroxide, tensile stress, temperatures greater than 250°F and times longer than 100 h. It was also found that a hydrogen meter can satisfactorily detect the end point of the bulk sodium/water vapor reaction. (auth)

32813 (HEDL-TME-74-65) PROTOTYPE APPLICATIONS LOOP COLD TRAP FLOWMETER CALIBRATION. Cappiello, M. W. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 31 Oct 1974. Contract AT(45-0)-2170. 30p. AT.

Calibration of a sodium permanent magnet flowmeter was required prior to its installation in the Prototype Applications Loop (PAL). The calibration was performed in the Mark II-C Flowmeter Calibration Stand adjacent to PAL. The observed calibration data was reduced to a set of four linear equations which give the relation between fluid flow rate (lbm/min) and flowmeter output (Mv) at four calibration temperatures. An approximate error of 1% was expected due to the precision of the calibration equipment. Theoretical predictions of the calibration equations were performed according to RDT C4-5T (standard for permanent magnet liquid metal flowmeters). Comparison to the physical calibration indicated a 10 to 14% difference. The conclusion was made that the theoretical calculations for the relation between flowrate and output signal for permanent magnet liquid metal flowmeters had only limited accuracy. (auth)

32814 (JAPFNR-180) MATERIALS MONITORING FACILITY (MMF) FOR FAST REACTOR MATERIAL TESTING. Uematsu, K.; Ishida, Y.; Suzuki, K.; Yamanouchi, S. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). 1974. 22p. (PNC-D-023-74-01-8). Dep. NTIS (US Sales Only) $4.00.

Work performed under United States–Japanese Fast Reactor Exchange Program.

For the development of reactor structural materials and cladding tubes for fast reactors, the Materials Monitoring Facility (MMF) was constructed at O-arai Engineering Center of Power Reactor and Nuclear Fuel Development Corporation. This facility consists of six concrete and two lead cells for high temperature mechanical testing of irradiated materials. Biaxial creep testing, uniaxial creep testing, tensile testing, tension compression fatigue testing, and Charpy testing are the main items of mechanical testing. For supporting these tests, metallography, densitometry, mensuration, electron microscopy, and other special test are provided. (auth)

32815 (NTO-R-0115) NTO TEST REPORT FOR ENGINE TEST COMPARTMENT PURGE TESTS. Compartment Experimental Plan I. (NERVA Test Operations, Jackass Flats, Nev. (USA)). [nd]. 75p. Dep. NTIS $6.75.

The ETS-1 Engine Test Compartment (ETC) Purge Tests were conducted on May 11, 1967. The type of tests conducted were purging the ETC and NES Duct with various flow rates, and obtaining the maximum flow, consistent with the safe operating limit, for the two purge supply systems. The tests revealed that the ETC and NES Duct inerted in the time expected, and approximately 850 pounds of gaseous nitrogen was required. There was no significant leakage of air into the ETC after it had been inerted and the inerting purge terminated. The permanent oxygen analyzer system performed adequately and the sample points appeared to accurately describe the ETC inerting conditions. The purge supply system will have to be modified because the maximum flow was higher than predicted and will overstress the purge line if PCV-446 fails open. (auth)

32816 (NTO-SOP-0090(Rev.1)) QUALITY AND WORKMANSHIP MANUAL FOR WELDING. Revision 1. Phillips, M. D. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 30 Apr 1968. 82p. Dep. NTIS $7.25.

This manual is a compilation of general weld information and pictorial presentations which are to serve as a workmanship guide to the planning and achievement of fusion welding for NERVA Test Operations at the Nuclear Rocket Development Station, Jackass Flats, Nevada. It provides the type of workmanship and quality of welding conducive to the requirements for fusion welding of component piping and assemblies associated with the nuclear rocket engine and its test systems. (auth)

32817 (NTO-T-0003) ETS-1 CONSOLE OPERATIONS MANUAL. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 1967. 75p. Dep. NTIS $6.75.

The Facility Engineer-Left (FEL) console for Engine Test Stand-1 of the NERVA program is used to start, operate, and shutdown the three steam generators and to control all flow systems associated with the operation of the steam generators. This manual provides operational information about the FEL console and discusses related systems. (LCL)

32818 (RD/B/N-2785) FINITE ELEMENT CRACK ANALYSIS USING THE J-INTEGRAL METHOD. Neale, B. K. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Sep 1973. 27p. Dep. NTIS (US Sales Only) $4.50.

The application of Rice's contour integral to linear elastic fracture mechanics using a finite element analysis is described. With this method it is shown that accurate stress intensity factors can be determined even for coarse meshes providing that the crack tip singularity is modeled. Modified isoparametric finite elements are used to produce the crack tip singularity. Comparison with the special crack tip elements indicates the inherent attractiveness of modified isoparametric finite elements is used to produce the crack tip singularity. Comparison with the special crack tip elements indicates the inherent attractiveness of modified isoparametric finite elements. Also contained is an adequate working description of the computer program used to evaluate the contour integral, which should enable others to make full use of the program. The crack can be inclined at any arbitrary angle and be enclosed by any arbitrary path. There is no restriction on the element types within the program. (auth)

32819 (TID/SNA-1510) FEO-1 NERVA FACILITY STRUCTURAL DESIGN STANDARDS. (Braun (C.F.) and Co., Alhambra, Calif. (USA)). Oct 1970. 60p. Dep. NTIS $6.00.

These Design Standards guide the implementation of the intent and philosophy of the NERVA Program Structural Design Requirements, SNPO-C-1, for the design of test facilities. They define the minimum requirements for structural analysis and the minimum criteria for the structural design of NERVA program test facilities and test support equipment. Three major categories of facility components are covered, i.e., structures, piping, and vessels. (auth)

32820 (WANL-TME-227) E-MAD FACILITY PHASE II PRELIMINARY DESIGN. Ricks, L. O. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 13 Dec 1962. 1p. Dep. NTIS $4.00.

A review was made of shielding design criteria and basis for the E-MAD hot cells as reported in KLX-1844. The design criteria was found to be in accordance with current regulations and was based on the latest radiation sources. The design analysis appears similar to that used for the E-MAD main bay. It appears that the basic shield design for the hot cells will be adequate for NERVA components. (auth)

32821 (WANL-TME-265) REVIEW OF VITRO E-MAD DRAWINGS. Svasek, A. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Feb 1963. 1p. Dep. NTIS $4.00.

32822 (WANL-TMI-855) BAR-X AND K-SEAL EVALUATION TESTS. Jacob, W. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 7 Nov 1973. 18p. Dep. NTIS $4.00.

Tests performed to determine the gaseous hydrogen leakage of Bar-X and K-seals under ambient and cryogenic conditions are described. The effects of seal load, temperature, and pressure on the seals and the effect of a heat treated shaft surface on Bar-X sealing were determined. The results of 17 leakage tests on the Bar-X and K-seals indicated that the loading nut must be torqued to between 200 and 250 ft-lb in order to insure safe operation of the components dependent on these seals during NRX-A power runs. It is recommended that a lock nut or lock washer be added to any seal system designed similar to the test fixture. It was found that after cold soaking the nut load was relieved. (LCL)

32823 (WANL-TMI-1774) VAPOR DEPOSITED RHENIUM-COATED TUNGSTEN CUPS. Spofford, N. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 21 Apr 1967. 4p. Dep. NTIS $4.00.

A set of current production rhenium-coated vapor-deposited tungsten cups was tested at 1100 lb load for one hour at 4300°R. Hydrogen was passed through the test specimens at the rate of 3.1 scfm while the furnace was at temperature. The cups' surfaces were rhenium coated to observe the effect on prevention of carburization of the tungsten substrata. Post test observation of the test specimens showed no discoloration, blistering, or cracking of the surfaces. Geometrical measurements showed a slight enlargement of the outer diameter of the smaller cup (1.6 mils) and a questionable enlargement of the larger cup (0.3 mils). The gap between the cup rim and block surface was reduced approximately four mils during the hour at temperature. Some discussion was generated as to whether there were radial cracks in the inner bore of the cup bottoms so sectioning was requested to explore this area. This set of cups was by far the best appearing of all the vapor deposited cups tested. (auth)

32824 (WANL-TMI-1938) RADIAL SEAL TEST RESULTS. Morgan, L. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 13 Sep 1968. 2p. Dep. NTIS $4.00.

A small diameter servo-flex radial seal was tested to determine its sealing and flexure characteristics to provide design information on its potential as a seal for the reactor reflector rings. The seal tested was a silver plated-stainless steel modified double omega type. Leakage of 9 SCFH occurred with no flange separation at a pressure differential of 275 psi. With the flange separated .005 inches, leakage in excess of 250 SCFH was experienced at only 15 psi pressure differential. Since the leakage with .005 inch flange separation and 15 psi pressure differential was excessive, it was concluded that this prototype seal did not have the required characteristics necessary for a reflector seal and no further testing will be conducted on this particular configuration seal. (auth)

32825 (WANL-TR-6541) TRIP TO BATTELLE MEMORIAL INSTITUTE, COLUMBUS, OHIO. Spitz, H. Y. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 Oct 1970. 5p. Dep. NTIS $4.00.

A trip for the purpose of evaluating equipment for performing friction tests on candidate materials for the corrosion resistant periphery of the NERVA rocket is reported. (LCL)

32826 BURNOUT CORRELATIONS IN SIMPLE GEOMETRIES. Most Recent Assessments. Becker, K. M.; Bager, J. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden)); Djursing, D. (Swedish State Power Board, Stockholm, Sweden). pp 51-87 of Two-Phase Fluid Thermodynamics. Proceedings of a Symposium Organized by CNEN Under the Sponsorship of the Italian-Latin American Institution. Rome; CNEN (1973).

From Two-phase flow day; Rome, Italy (9 Jun 1972). 22 refs.

The Milan reproducibility burnout tests have been used for an assessment of the Tong, CISE, Macbeth, Hewitt and Becker correlations. The best predictions were obtained with Becker correlation, which for mass velocities up to 4000 kg/m^2 gave an RMS error of 5.08 per cent. For the pressure range between 100 and 200 bar a comparison with the burnout data obtained showed that none of the mentioned correlations performed satisfactorily. However, it was demonstrated that the Bailey, the Peskov, and the new Becker correlations for high pressures, agreed with these data, as well as with data from other sources. (INIS)

32827 MULTIPURPOSE SAMPLER DEVICE FOR LIQUID METAL. Nelson, P. A.; Kolba, V. M.; Holmes, J. T. (to United States Energy Research and Development Administration). US Patent 3,872,718. 25 Mar 1975. Filed date 30 Oct 1973. 10p.

A device for collecting samples or examining a flow of liquid metal is provided for use with such as a liquid-metal-cooled nuclear reactor. The sampler device includes a casing surrounded by an external heater for establishing an upper isothermal zone and a lower zone for heating the entering liquid metal. One of various inserts is suspended into the isothermal zone where it is surrounded by a shroud tube for directing liquid-metal flow from the heating zone into the top of the insert. Discharge flow from the insert gravitates through a helically wound tube in heat exchange contact with entering liquid-metal flow within the heating zone. The inserts comprise an overflow cup with upper and lower freeze seals, a filter for removing particulate matter, and a fixture for maintaining various sample materials in equilibrium with liquid-metal flow. (Official Gazette)

32828 COLD TRAP FOR LIQUID SODIUM IMPURITIES COLLECTION. Pohl, L. E. (to United States Energy Research and Development Administration). US Patent 3,873,447. 25 Mar 1975. Filed date 21 Dec 1973. 10p.

A device for removing and storing impurities found in high temperature sodium or other liquid metal loops of nuclear reactors is described. Utilization of the crystallizer zone is increased by organizing and directing the incoming flow in such a way that the impurities accumulate progressively from the bottom toward the top. This is accomplished by segregating the flow into several controllable sections. (Official Gazette)

32829 LIQUID METAL OPERATED HEAT EXCHANGER. Petrek, J. P. (to United States Energy Research and Development Administration). US Patent 3,868,994. 4 Mar 1975. Filed date 26 Feb 1973. 10p.

This invention relates to a heat exchanger arrangement of the shell and tube type especially adapted for the use of high temperature liquid metal as a heating medium. The arrangement incorporates a tube bundle comprising a plurality of bayonet tube assemblies through which the liquid metal is circulated in indirect heat exchange relation with vaporizable fluid that flows through the shell. The tube assemblies incorporate a double walled bayonet tube containing a gas space which provides a thermal barrier to minimize heat loss from the heating medium. Various embodiments of evaporator and evaporator-superheater organizations utilizing the heat exchanger arrangement are described. (Official Gazette)

Lasers

Refer also to abstracts 32762 and 32765.

32830 (AD/A-000038) INVESTIGATION OF GENERATION AND PROPAGATION OF INTENSE RADIATION. Final Report, March 1973 - March 1974. Hopf, F. A.; Ragovin, D. N.; Sargent, M. III; Sully, M. O.; Shih, H. (Arizona Univ., Tucson (USA)). Aug 1974. Contract F29601-73-C-0056. 41p. (AFML-TR-74-68). NTIS $3.75.

Research is described that provided fundamental theoretical support of the high-energy laser program, particularly with regard to concepts germane to that program several years hence. The work has centered in four major areas: propagation of intense radiation; laser theory; amplifier theory; and molecular physics

(particularly of the water molecule). This report summarizes the work completed under the contract and provides references to more detailed accounts of that work published elsewhere. Included are abstracts of papers published (or to be published) elsewhere. Among the highlights of the collected final report are a strikingly successful, yet simple, model of the H_2O molecule; a very promising scheme for a soft x-ray laser; further advances in the multimode unstable resonator theory; and justification of the rate equation approach to treating lasers with cascade transitions. (GRA)

32831 (AD/A-000219) GENERATION SPECTRA OF RUBY LASER WITH FREQUENCY SCANNING. Zhupan, Yu. Yu.; Zaika, V. V.; Kravchenko, V. I. Translated from Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 11, 1803-1808(Nov 1972). 12p. (FSTC-HT-23-1745-73). NTIS $3.25.

Generation spectra and kinetics of frequency scanning ruby lasers were investigated over a wide range of scanning velocities. It is shown that, at high velocities, generation is essentially determined by the properties of the cavity with phase aberration. (GRA)

32832 (AD/A-000270) BIBLIOGRAPHY OF SOVIET LASER DEVELOPMENTS. Number 16, April-June 1974. Hibben, S. G. (Informatics, Inc., Rockville, Md. (USA)). 1 Nov 1974. Contract N00600-75-C-0018. 130p. NTIS $5.75.

This is the Soviet laser bibliography for the second quarter of 1974 and is No. 16 in the series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; crystal growing; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications; computer technology; holography; laser-induced chemical reactions; instrumentation and measurements; beam-target interaction; and plasma generation and diagnostics. (GRA)

32833 (AD/A-000357) STUDY OF THE AMPLIFICATION OF LIGHT IN A PULSED GAS-DYNAMIC LASER WITH THE COMBUSTION OF ACETYLENE-AIR MIXTURES. Kozlov, G. I.; Ivanov, V. N.; Korablev, A. S. Translated by C. T. Ostertag Jr. from Zh. Eksp. Teor. Fiz.; 65: No. 1, 82-87(1973). 17p. NTIS $3.25.

Values were measured of the amplification factors of the products of combustion of acetylene-air mixtures during expansion in a hypersonic nozzle depending on the stagnation parameters and concentration of acetylene in the initial mixture. It is shown that during shock wave propagation in a gas with inverse population density first an increase in the amplification occurs, and then a rapid transition from amplification to absorption. (GRA)

32834 (AD/A-000418) COLD CATHODE ELECTRON BEAM CONTROLLED CO_2 LASER PERFORMANCE. Final Report, 6 July 1972-5 December 1973. McKee, L. L. III; Patterson, S. R.; Lindstrand, R. A.; Kinkade, R. P. (Air Force Weapons Lab., Kirtland AFB, N. Mex. (USA)). Oct 1974. 28p. (AFWL-TR-74-163). NTIS $3.75.

A cold cathode electron beam controlled CO_2 laser has been constructed. The laser has produced up to 50 J of output energy and peak powers as high as 1 GW. Various laser system parameters which control the laser output have been investigated. The laser performance has been compared with theoretical studies. (auth)

32835 (AD/A-000572) TURBULENT SHEAR FLOWS IN LASER NOZZLES AND CAVITIES. Final Technical Report, February-October 1974. Varma, A. K.; Beddini, R. A.; Sullivan, R. D.; Fishburne, E. S. (Aeronautical Research Associates of Princeton, Inc., N. J. (USA)). Oct 1974. Contract F44620-73-C-0027. 44p. (ARAP-231; AFOSR-TR-74-1786). NTIS $3.75.

An invariant second-order closure program for compressible, turbulent, reacting shear flows is being developed. The development of models for the third and higher-order correlations that appear in the transport equations has been completed. A "typical eddy" box model has been developed for computation of higher-order scalar correlations involving species, temperatures and reaction rate fluctuations. A single species second-order closure program for compressible shear flows has been applied to study a simulation of the mixing region in a HF chemical laser. Considerable insight into the complex processes occurring in laser cavities has been achieved. The results show that the assumptions used in the eddy viscosity and the turbulent kinetic energy closure methods are not completely valid for nonequilibrium flows such as in the chemical laser system. The results of studies of other shear flows with the same invariant second-order model are in generally good agreement with experimental measurements. (auth)

32836 (AD/A-000584) INVESTIGATION OF GAS DYNAMIC PHENOMENA ASSOCIATED WITH HIGH POWER LASERS. Final Report, August 1973-June 1974. Fishburne, E. S.; Snedeker, R. S.; Donaldson, C. D. (Aeronautical Research Associates of Princeton, Inc., N. J. (USA)). Sep 1974. 77p. (ARAP-228; AFOSR-TR-74-1721). NTIS $4.75.

An experimental and theoretical investigation was made on the Rocketdyne 75-inch full scale vertical vaned diffuser. Boundary layer blowing, employing several types of injectors and two points of injection, increased the diffuser performance over that obtained without blowing. Experimental evidence confirmed the theoretical predictions that boundary layer injection near the point of the supersonic portion of the diffuser, as opposed to injection at the entrance, would provide the best performance. A major problem was the rather poor quality of the flow produced by the temporary air supply and Mach 5 nozzle. The aerodynamic windows in the end walls of the laser cavity did not significantly affect the diffuser performance. Diagrams are included. (auth)

32837 (AD/A-000892) FEASIBILITY OF NEW LASERS. Final Report, 15 April-26 September 1974. Hall, L. H. (Rocketdyne, Canoga Park, Calif. (USA)). 8 Nov 1974. 62p. (R-9597; RK-CR-75-16). NTIS $4.25.

The objective of the study was to investigate selected alkali-metal halogen reactions to evaluate their potential for new chemical lasers at suitable wavelengths. The chemiluminescence of the alkali-metal atoms was spectroscopically observed and was analyzed to measure population inversions in the excited electronic states of the alkali-metal atoms as a function of reaction conditions. The conditions included nozzle configuration, reactant ratios, and reactant pressures for the Cs/F_2 reaction system. Spatial scans were performed, and gains were calculated for all observed population inversions. Absorption and extinction experiments were also performed. The results of this study have established the reaction conditions for the Cs/F_2 system most likely to give lasing. (GRA)

32838 (AD/A-000903) PRODUCTION ENGINEERING MEASURE FOR OPTICAL PUMPS FOR LASERS. Quarterly Report No. 4, April-June 1974. Maynard, R.; Sowers, H. (ILC Technology, Inc., Sunnyvale, Calif. (USA)). Aug 1974. Contract DAAB05-73-C-2078. 38p. (R-ILC-73-22/Q4).

The program is directed towards establishing a capability for manufacturing flashlamps that are to be used as optical pumps for laser systems. Optical pump 1 is designed for liquid-cooled operation and optical pump 2 is designed for cooling by compressed nitrogen gas. The program consists of design, fabrication and testing. (GRA)

32839 (AD/A-000911) EVALUATION OF ND:YVO_4 AND Ho:Er:Tm:YVO_4 AS PULSE PUMPED Q-SWITCHED LASERS. Semiannual Technical Report, 1 January-1 July 1974. Bass, M.; Deshazer, L. G.; Ranon, U. (University of Southern California, Los Angeles (USA)). Jul 1974. Contract DAAB07-74-C-0104. 61p. (ECOM-74-0104-1). NTIS $4.25.

Yttrium orthovanadate (YVO_4) doped with rare earth ions was investigated for use as a pulse pumped Q-switched laser material. Two laser ions were studied in detail: Nd^{3+} and Ho^{3+} sensitized with erbium and thulium. Measurements of the optical absorption and emission spectra, energy levels and stimulated emission cross-sections are reported. Crystal growth and laser performance are discussed. (GRA)

32840 (AD/A-001062) MOLECULAR LASERS IN E-BEAM STABILIZED DISCHARGES. Semiannual No. 3, 15 May-15 November 1973. Byron, S. R.; Nelson, L. Y.; Fisher, C. H.; Mullaney, G. J.; Pindroh, A. L. (Mathematical Sciences Northwest, Inc., Seattle, Wash. (USA)). Aug 1974. 67p. (MSNW-74-105-3). NTIS $4.25.

The reported program is directed toward developing efficient, high energy density electric discharge lasers in the infrared and visible regions of the spectrum. A high current, electron-beam-stabilized electric discharge is used for excitation. Infrared laser emission and absorption from the vibrational levels of HF (2.8 to 3.1 micrometers) and DF (3.8 to 4.1 micrometers) in various gas mixtures is being studied to determine laser efficiency and to obtain a detailed model of the vibrational kinetics. The efficiency of electric discharge excitation of molecular vibration in these gases is being determined by solving the electron Boltzmann equation. Electronic state excitation by E-beam stabilized electric discharges in N_2 and other molecular systems is being investigated in an effort to develop efficient, long pulse visible lasers. (GRA)

32841 (AD/A-001290) HIGH PRESSURE ELECTRIC DISCHARGE CONVECTION LASER. A Preliminary Study. Osani, J. R. (Naval Postgraduate School, Monterey, Calif. (USA)). Sep 1974. 43p. NTIS $3.75.

Thesis.

The fabrication and feasibility demonstration of a continuous flow, electric-discharge convection laser using a mixture of CO_2,

N_2, and H_2O at atmospheric pressure was attempted. Electric discharge studies in air and nitrogen using a turbulence stabilization technique formed a large part of this project. Controlled turbulence can stabilize gaseous electric discharges as previously demonstrated, and the discharge studies of this project represent an application of such controlled turbulence to increase the discharge power of the laser. In this preliminary study, no laser action was detected. Several reasons for this lack of laser action are suggested. (GRA)

32842 (AD/A-001384) RARE EARTH COMPOUND LASER. Final Technical Report, 1 February 1973–30 June 1974. Lempicki, A.; Riseberg, L. A.; Brecher, C. (GTE Labs., Inc., Waltham, Mass. (USA)). Nov 1974. Contract N00014-73-C-0299. 58p. NTIS $4.25.

An investigation into the possibility of obtaining laser action in stoichiometric rare earth compounds by low velocity electron beam excitation was conducted. The chemistry, spectroscopy, and crystal structure of ultraphosphates are described. Photoluminescent spectra are compared. Absorption and emission spectra are reported and analyzed. Using 5 AD electron guns operated at 3 kV and providing a power flux of 40 W/cm^2 at the sample, the volume excitation rates of rare earth ions are found to be approximately two orders of magnitude below threshold requirements. Suggestions for achieving laser action under modified conditions are formulated. (GRA)

32843 (AD/A-001557) REACTIVE ATMOSPHERE GROWTH OF 2.06 MICRON LASER CRYSTALS. Final Technical Report, 11 September 1973–8 June 1974. Devor, D. P.; Pastor, R. C.; Robinson, M.; Akutagawa, W. M.; Arita, K. (Hughes Research Labs., Malibu, Calif. (USA)). Oct 1974. 98p. (ECOM-74-0034-F). NTIS $4.75.

A specified formula Y (0.428) Er (0.500) Tm (0.067) Ho (0.005) LiF_4 was used as a first approximation to a laser system whereby the necessary broad pump bands and fast, efficient laser excitation could be obtained. Laser rods were cut from single crystal ingots grown by a reactive atmosphere process (RAP). Thermal conductivity, hardness, elastic modulus, rupture strength, radiative characteristics, and laser test data were measured to determine the laser performance characteristics of Ho : YLF. Development of RAP Ho : YLF growth procedures provided proof of practical, congruent melting behavior. Electron probe, spectrographic analysis, and backscatter measurements showed R (3^+) (R = Y + Er + Tm + Ho in Ho : YLF) acted as one ionic species in crystal growth. Glass-like optical quality of Ho : YLF was RAP Czochralski grown at 5 mm/h. A short investigation of Bridgman growth indicated that higher yields and inexpensively scaled-up rod production technology can be developed. (GRA)

32844 (COO-2007-50) LASING IN A TERNARY MIXTURE OF He–Ne–O_2 AT PRESSURES UP TO 200 TORR. DeYoung, R.; Beckman, S.; Wells, W. E.; Miley, G. H. (Illinois Univ., Chicago (USA)). 1974. 9p. (CONF-7410100-1). Dep. NTIS $4.00.

From 27th annual gaseous electronics conference; Houston, Texas, USA (22 Oct 1974).

The problems of rapid deterioration which usually beset lasing in mixtures with oxygen have been avoided in a ternary mixture of He–Ne–O_2. Stable lasing has been obtained on the 8446Å line in atomic oxygen in a pulse mode up to pressures of 200 torr. The upper pressure limit is due mainly to the difficulties in creating discharges above this value. Significant improvements in output power have been obtained with the addition of helium due to the increased production of Ne metastables which collisionally dissociate O_2 to form the upper states for the 8446Å transitions. Concentration studies and crude measurements of the combination of O into O_2 in the presence of He is also presented. A wavelength shift, due to the selective absorption of the lower level to ground state transition, should be expected. This was examined theoretically but has not yet been confirmed experimentally. (auth)

32845 (NTIS/PS-74/120) DYE LASERS. A Bibliography With Abstracts. Report for 1964–September 1974. Lehmann, E. J. (National Technical Information Service, Springfield, Va. (USA)). Dec 1974. 156p. NTIS $20.00.

This bibliography contains 140 selected abstracts of research reports retrieved using the NTIS on-line search system–NTISEARCH. The cited reports cover all aspects of dye lasers. This includes studies on tuning, optics, pumping, molecular energy levels, and dye laser spectroscopy. (GRA)

32846 STABILIZATION OF THE EMISSION FREQUENCY OF A CARBON DIOXIDE LASER BY AN EXTERNAL NONLINEARLY ABSORBING SF_6 CELL. Kompanets, O. N.; Kukudzhanov, A. R.; Letokhov, V. S.; Mikhailov, E. L. Sov. J. Quantum Electron.; 3: No. 4, 293-296(1974).

Translated from Kvantovaya Elektron (Moscow); 3: No. 4, 28-34(1974).

The use of narrow resonances in the absorption of SF_6 at low pressures under saturation conditions to stabilize the emission frequency of a CO_2 laser is demonstrated. Two such stabilized lasers had a relative stability of 3×10^{-11} over a period of 10 min. Factors influencing stability, frequency pulling and reproducibility are discussed. A number of further improvements are suggested. Application of these methods should permit an improvement of frequency stability by one to two orders of magnitude. (Elect. Electron. Abstr.)

32847 PUMPING OF NUCLEAR LEVELS BY X-RAY RADIATION OF LASER PLASMA. Letokhov, V. S. Sov. J. Quantum Electron.; 3: No. 4, 360-361(1974).

Translated from Kvantovaya Elektron (Moscow); 3: No. 4, 125-127(1974).

The excitation of low lying nuclear levels by x-ray pulses emitted by a high temperature laser plasma is considered theoretically. Both two- and three-level systems are examined. It is concluded that it should be possible to achieve the emission of strong, narrow γ-ray lines from recoilless nuclei. (Elect. Electron. Abstr.)

32848 POSSIBLE METHOD FOR THE STABILIZATION OF THE STIMULATED EMISSION OF A RAMAN LASER AT THE FIRST STOKES FREQUENCY. Bel'dyugin, I. M.; Virnik, Ya. Z.; Egoshin, E. I.; Zemskov, E. M.; Fedulov, I. A. Sov. J. Quantum Electron.; 3: No. 4, 353-354(1974).

Translated from Kvantovaya Elektron (Moscow); 3: No. 4, 118-120(1974).

It is shown theoretically that pumping of a Raman laser by simultaneous longitudinal and transverse beams allows the possibility of stabilization of the emission of the first Stokes component. The properties of the photon flux densities of both pumping and output beams are discussed. (Elect. Electron. Abstr.)

32849 NONLINEAR TOTAL INTERNAL REFLECTION AND ITS UTILIZATION IN RUBY LASER MODE LOCKING. Rubinov, A. N.; Korda, I. M. Sov. J. Quantum Electron.; 3: No. 4, 334 (1974).

Translated from Kvantovaya Elektron (Moscow); 3: No. 4, 96-97 (1974).

Total internal reflection at the surface of a nonlinearly absorbing material is modified due to the finite penetration of the less dense medium. A phototropic dye was used in this way to achieve Q-switching and mode locking of a ruby laser. For a pumping power exceeding threshold by 1 to 2% a train of picosecond pulses with a modulation depth close to 100% was produced. This optical configuration makes it simpler to combine a reflector and modulator in a single element. (Elect. Electron. Abstr.)

32850 MEASUREMENT OF THE SCATTERING OF LASER MIRRORS IN REFLECTION OF A DOMINANT-MODE BEAM PRODUCED BY A CARBON DIOXIDE LASER. Apollonov, V. V.; Barchukov, A. I.; Konyukhov, V. K. Sov. J. Quantum Electron.; 3: No. 4, 341-342(1974).

Translated from Kvantovaya Elektron (Moscow); 3: No. 4, 103-105(1974).

A quasi-optic transmission line using multiple mirrors was utilized to examine the absolute scattering losses at mechanically polished copper or aluminium surfaces. The results are discussed in the light of the observed surface irregularities and compared with the measured absorption losses. (Elect. Electron. Abstr.)

32851 TUNABLE RESONATOR WITH A MIRROR OF VARIABLE CURVATURE. Belomestnov, P. I.; Vyazovich, E. I.; Soloukhin, R. I.; Yakobi, Yu. A. Sov. J. Quantum Electron.; 3: No. 4, 347-348(1974).

Translated from Kvantovaya Elektron (Moscow); 3: No. 4, 110-113(1974).

A variable curvature mirror was constructed from a circular plate distorted by applying a load to the plate center. The shape of the mirror was investigated using a Michelson technique. The performance of the mirror in a CO_2 laser is described in terms of output power and mode composition. (Elect. Electron. Abstr.)

32852 LOCKING OF TRANSVERSE MODES IN A RAMAN LASER. Akandev, B. A.; Bel'dyugin, I. M. Sov. J. Quantum Electron.; 3: No. 4, 317-320(1974).

Translated from Kvantovaya Elekron. (Moscow); 3: No. 4, 69-75 (1974).

It is shown theoretically that the transverse Stokes modes in a monochromatically excited Raman laser with a plane parallel resonator are locked by the amplitude and phase distribution of the exciting radiation. The conditions necessary for producing a specific transverse mode are discussed. The technique is illustrated by considering the excitation of two and three linearly

polarized transverse modes in a plane parallel resonator. (Elect. Electron. Abstr.)

32853 ENHANCEMENT OF THE BRIGHTNESS OF THE OUTPUT OF NEODYMIUM-GLASS LASERS BY SELECTION OF THE COMPOSITION OF THE ACTIVE-ELEMENT MATRIX. Bubnov, M. M.; Buzhinskii, I. M.; Dianov, E. M.; Mamonov, S. K.; Mikhailova, L. I.; Prokhorov, A. M. Sov. J. Quantum Electron.; 3: No. 4, 349-350(1974).

Translated from Kvantovaya Elekron. (Moscow); 3: No. 4, 113-115(1974).

The results of measurements of thermal deformations, divergence of the output radiation and efficiencies of several neodymium-glass lasers are discussed in terms of the thermooptic constants of the glass matrices. It was found that replacement of commercial glass by laboratory glass reduced the level of deformations and also of the beam divergence, but did not affect the efficiency significantly. (Elect. Electron. Abstr.)

32854 LOW-TEMPERATURE EMISSION FROM A RUBY LASER WITH A PASSIVE SWITCH. Leontovich, A. M.; Baeva, E. D.; Mozharovskii, A. M. Sov. J. Quantum Electron.; 3: No. 4, 343-344(1974).

Translated from Kvantovaya Elekron. (Moscow); 3: No. 4, 106-108(1974).

Cooling the rod of a ruby laser makes it possible to observe the effects of using a saturable filter with a relatively low initial transmission. Giant pulses with a minimum width of 2.2 nsec were obtained. Under mode locking conditions and for initial filter transmissions of less than 1% it was possible to select a single mode locked pulse, with duration ~0.3 nsec and peak power ~6 GW/cm^2. (Elect. Electron. Abstr.)

32855 INFLUENCE OF $Al_xGa_{1-x}As$ LAYER THICKNESS ON THRESHOLD CURRENT DENSITY AND DIFFERENTIAL QUANTUM EFFICIENCY FOR GaAs–$Al_xGa_{1-x}As$ DH LASERS. Casey, H. C. Jr.; Panish, M. B. (Bell Labs., Murray Hill, NJ). J. Appl. Phys.; 46: No. 3, 1393-1395(Mar 1975).

Measurements of the threshold current density J_{th} and differential quantum efficiency η_d have been made on GaAs–$Al_{0.3}Ga_{0.7}As$ double-heterostructure (DH) lasers to determine the effect of $Al_xGa_{1-x}As$ layer thickness on J_{th} and η_d. For DH lasers with active layer thicknesses near 0.12 μ, J_{th} increases and η_d decreases drastically for p-type $Al_{0.3}Ga_{0.7}As$ layers less than ~0.8 μ in thickness. This effect is also considered for other values of active layer thickness d, and AlAs mole fraction x. (auth)

32856 THEORY OF A GAS LASER WITH A GAUSSIAN FIELD PROFILE. Maeda, H. (Makishima-cho, Kyoto); Shimoda, K. J. Appl. Phys.; 46: No. 3, 1235-1239(Mar 1975).

A theory for a gas laser with a Gaussian radial field distribution is considered. Rotating wave approximation is adopted to calculate the atomic polarization of the two-level system. An asymmetry of the shape of the Lamb dip and a shift of its center frequency are numerically obtained in the self-consistent laser field. (auth)

32857 RATE-EQUATION APPROACH IN GAS-LASER THEORY: ANALYTICAL SOLUTION FOR ONE-MODE OPERATION. Bambini, A. (CNR, Florence); Troup, G. J. J. Appl. Phys.; 46: No. 3, 1261-1270(Mar 1975).

A detailed treatment of gas-laser operation is given in the rate-equation approach. One running mode and one standing mode operations are fully developed and analytical formulas are deduced for the gain and the dispersion curves. While well known, this method suggests itself for its simplicity and for its good agreement with experimental results. The aim of the present paper is to give the final form of analytical formulas, i.e., the nonlinear Voigt profile. Furthermore, these formulas turn out to be a good starting point in a deeper investigation of the nonlinear dispersion relations, because the only approximation used is in the interaction model, while the analytical treatment is not perturbative. The modified Kramers-Kronig (MKK) relations are, in fact, satisfied for running-mode formulas. (auth)

32858 GAIN SPECTRA IN GaAs DOUBLE-HETEROSTRUCTURE INJECTION LASERS. Hakki, B. W.; Paoli, T. L. (Bell Labs, Murray Hill, NJ). J. Appl. Phys.; 46: No. 3, 1299-1306 (Mar 1975).

Gain spectra for GaAs double-heterostructure junction lasers have been obtained with high resolution. This is accomplished by using an automated data acquisition system to analyze the Fabry-Perot resonance modulation in the spontaneous emission spectra. For active regions doped with Ge at a level of 4×10^{17} cm^{-3}, the gain in the TE polarization at a fixed wavelength increases linearly with current, below lasing threshold. However, the peak gain (at a variable wavelength) increases slightly faster than linearly with current. The photon energy at which gain is a maximum increases logarithmically with current. Gain in the TM polarization depicts the same general behavior as that for the TE case, except that it is slightly less than the TE gain. It is concluded that for this particular doping the spectral gain characteristics are intermediate between those for undoped and heavily doped active regions. Above the threshold for lasing in the TE mode the TE gain spectra are well saturated, with new fine details revealed in the saturated spectra. On the other hand, gain in the nonlasing TM polarization is not well saturated above threshold, with marked differences in gain between high and low photon energies relative to the TE lasing energy. (auth)

32859 REDUCTION OF THE PUMPING EFFICIENCY IN CO_2 LASERS AT HIGH DISCHARGE ENERGY. Ballik, E. A.; Garside, B. K.; Reid, J.; Tricker, T. (McMaster Univ., Hamilton, Ont.). J. Appl. Phys.; 46: No. 3, 1322-1331(Mar 1975).

It has frequently been observed that, beyond a certain point, the gain obtained in TE CO_2 lasers fails to increase with increasing discharge input energy. This saturation effect could be caused by problems of a secondary nature such as the onset of discharge deterioration, or the effects of increasing gas temperature. On the other hand, an intrinsic property of the discharge may be responsible for this limitation on the pumping efficiency. In this paper, evidence is presented in favor of the latter possibility. Measurements of small-signal gain have been carried out in He : CO_2 and He : N_2 : CO_2 gas mixtures at moderately low pressure in a transversely excited resistor-pin amplifier. It is shown that this system permits the clear separation of the region of discharge deterioration from the onset of gain saturation. Furthermore, auxiliary measurements are undertaken which permit corrections to be made for the effects of increasing gas temperature. The net result is that the discharge pumping effectiveness at high energies falls to values drastically below those obtained at low discharge energies. This saturation effect occurs in a manner consistent with the existence in the discharge of a deexcitation process for the upper laser level. If such a deexcitation process indeed accounts for these observations, the cross section must be an order of magnitude higher than the corresponding excitation process. (auth)

32860 WIDE BANDWIDTH DETECTION AND DISPLAY SYSTEM FOR USE WITH TEA CO_2 LASERS. Gilison, A. F.; Kimmitt, M. F.; Maggs, P. N. D.; Norris, B. (Univ. of Essex, Eng.). J. Appl. Phys.; 46: No. 3, 1413-1414(Mar 1975).

A photoconductive detector based on intravalence band transitions in p-type germanium is described. The detector responsivity is sufficient to drive a travelling-wave oscilloscope (Tektronix 519) without amplification, and consequently has an over-all bandwidth sufficient to display 300-ps-duration pulses from a mode-locked TEA CO_2 laser. (auth)

32861 EFFECT OF INHERENT AND INSTRUMENTAL NOISE ON THE LINEWIDTH OF AN OPTICALLY PUMPED SPIN LASER. Zhitnikov, R. A.; Klyushkin, P. A.; Semenov, V. V.; Fomin, G. V. (Polytechnical Inst., Moscow). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 9, 1238-1241(Mar 1974).

Translated from Zh. Tekh. Phys.; 43: No. 9, 1965-1972(Sep 1973).

The operation of a spin laser is analyzed taking account of inherent and instrumental noise. The active linewidth of an oscillating system which used optically oriented He atoms, lasing at the NMR frequency is evaluated numerically. (Elect. Electron. Abstr.)

32862 EMISSION OF LASER PULSES DUE TO TRANSITIONS FROM A RESONANCE TO A METASTABLE LEVEL IN BARIUM VAPOR. Isaev, A. A.; Kazaryan, M. A.; Petrash, G. G. Sov. J. Quantum Electron.; 3: No. 4, 258-259(1974).

Translated from Kvantovaya Elektron. (Moscow); 3: No. 4, 123-125(1974).

Pulse discharges in barium vapor at repetition frequencies up to 15 kHz were used to excite laser emission in the visible and the infrared. The occurrence of transitions between a resonance and a metastable level was observed for the first time. Individual transition wavelengths and their assignments are listed with cross section and efficiency data. (Elect. Electron. Abstr.)

32863 SELECTION OF VIBRATION–ROTATIONAL CARBON DIOXIDE LASER LINES BY A DIFFRACTION GRATING IN THE RESONATOR. Avtonomov, V. P.; Antrapov, E. T.; Goldina, N. D.; Gorelik, A. V.; Sobolev, N. N.; Ostapchenko, E. P.; Troitskii, Yu. T. Sov. J. Quantum Electron.; 3: No. 4, 345-346(1974).

Translated from Kvantovaya Elektron. (Moscow); 3: No. 4, 108-110(1974).

The selection of vibrational-rotational emission lines by incorporation of a diffraction grating inside the laser resonator is demonstrated. The selected lines obtained with different gratings are given and are compared with the lines using no grating and also with the carbon dioxide absorption spectrum. (Elect. Electron. Abstr.)

32864 LASER THEORY. Haken, H. (Univ. of Stuttgart). pp 283-314 of Atoms, Molecules, and Lasers. Vienna; International Atomic Energy Agency (1974).

See STI/PUB-356.

Topics discussed include gross features of laser light; basic features of the laser; the rate-equation approach; mode selection–survival of the fittest; the semi-classical approach; intensities and frequency shifts of the solid state laser; the gas laser; pulse propagation; quantum theory of the laser; Hamiltonian and quantum-mechanical Langevin equations; and analogy with phase transitions. (auth)

32865 LASERS: EXPERIMENTAL AND APPLICATIONS. Bradley, D. J. (Queen's Univ., Belfast). pp 315-373 of Atoms, Molecules, and Lasers. Vienna; International Atomic Energy Agency (1974).

See STI/PUB-356.

Topics discussed include laser and measurement techniques; organic dye lasers–frequency narrowing and tuning; pulsed dye lasers; continuous-working dye lasers; generation and measurement of ultra-short pulses; measurement of picosecond pulse durations; frequency-tunable mode-locked dye lasers; direct photoelectric measurements of picosecond pulses; electron-optical chronography; detection of satellite pulses and sub-structure from streak-camera measurements; measurement of cw mode-locked dye lasers; selective excitation spectroscopy; selective excitation of rubidium; stimulated Stokes and anti-Stokes electronic Raman scattering; and Ba I spectra. (auth)

32866 INTERACTION OF MODES WITH ORTHOGONAL AND PARALLEL POLARIZATIONS IN A GAS LASER. Vdovin, Yu. A.; Gubin, M. A.; Ermachenko, V. M.; Protsenko, E. D. Sov. J. Quantum Electron.; 3: No. 4, 297-301(1974).

Translated from Kvantovaya Elektron. (Moscow); 3: No. 4, 35-42 (1974).

The properties of a gas laser supporting two axial modes were investigated theoretically, with particular attention to the critical frequency (minimum mode spacing in the symmetric case) and the stability of the two mode emission. Experimental data using a two-mode He–Ne laser are compared with the predictions. (Elect. Electron. Abstr.)

32867 OPTICAL PUMPING INHOMOGENEITY EFFECTS IN LASERS AND IN STIMULATED SCATTERING. Self-Excitation Due to Distributed Feedback. Akhmanov, S. A.; Lyakhov, G. A. Zh. Eksp. Teor. Fiz.; 66: No. 1, 96-108(Jan 1974). (In Russian and English).

Inhomogeneity of the pump is the cause of distributed feedback (DFB) arising in amplifying systems with laser pumping. A theory is developed for coherent DFB in a three-level laser with inhomogeneous pumping. The self-excitation threshold is determined and the role of spatial harmonics of inverse population modulation is analyzed. DFB effects due to pumping inhomogeneity are also manifest in stimulated Raman scattering. Conditions for self-excitation of a Raman laser with coherent DFB are determined; the stationary nonlinear regime is discussed. Conditions are found for the appearance of stimulated Raman scattering instability related to DFB which may arise as a result of weak pumping reflections. The instability thresholds due to coherent DFB in amplifying systems are compared with those due to stochastic DFB related to random pumping inhomogeneity or to thermodynamic density fluctuations. DFB due to inhomogeneous depletion of inverse population was also analyzed. (Elect. Electron. Abstr.)

32868 RADIAL DISTRIBUTION OF THE REFRACTIVE INDEX AND AMPLIFICATION FACTOR IN THE ACTIVE MEDIUM OF A RUBY LASER WITH PLANE MIRRORS. Fesquet, J.; Irla, H.; Roig, J. (Univ. of Science and Tech. Languedoc, Montpellier, France). Compt. Rend., Ser. B; 278: No. 21, 935-938(20 May 1974). (In French).

At the moment of "spike emission", the real index and the complex index of the active medium have a radial distribution around the symmetry axis. The ruby behaves then as a divergent medium characterized by a focal length $-L_1$. The active medium characteristics for two similar ruby lasers are given. (Elect. Electron. Abstr.)

32869 RELAXATIONAL SHIFT OF THE STIMULATED EMISSION SPECTRA OF 9 RHODAMINE DYES ON LASER PUMPING. Neporent, B. S.; Shilov, V. B.; Lukomskii, G. V.; Spiro, A. G. (State Optical Inst., Leningrad). Chem. Phys. Lett.; 27: No. 3, 425-429(1 Aug 1974).

The time-resolved stimulated emission spectra of 9 rhodamine dye solutions have been investigated during excitation by the second harmonic of a monopulse Nd-laser (for one substance by dye laser radiation). The relaxational spectral shift of stimulated emission (RSS) is observed only for those substances characterized by inhomogeneously broadened configurational vibronic spectra. The linear dependence of the shift $\Delta\nu_{vm}$ on the stimulated emission field φ_ν in the cavity is shown. The probability W^v for the intramolecular vibrational relaxations causing the RSS is shown to depend on the position of the pumping ν_α and emission ν_ν frequencies relative to the frequency ν^{00} of the zeroth vibronic transition in active molecules. (Elect. Electron. Abstr.)

32870 CURRENT-PULSE GENERATOR FOR PUMPING SEMICONDUCTOR LASERS. Lantsov, Zh. G.; Toporkov, V. D.; Filatov, V. V. Avtomatika; No. 2, 103-106(1974). (In Russian).

In order to give constant radiative power output and stable operation of a laser across the temperature range −50 to +60°C, it is necessary to change the pumping current, in proportion to the change in threshold current. Two pulse generators are proposed, one based on thyristors, the other on magneto-thyristors, which give the required output over the temperature range. (Elect. Electron. Abstr.)

32871 CHEMICALLY PUMPED CO_2 LASER FROM THE CS_2/O_2 REACTION. Peterson, A. B.; Wittig, C. (Univ. of Southern California, Los Angeles). Chem. Phys. Lett.; 27: No. 3, 442-444(1 Aug 1974).

A chemical laser has been constructed in which simultaneous output is obtained from both CO and CO_2 laser species at 5 and 10 μm, respectively. Excitation of CO_2 is via energy transfer from vibrationally excited CO (CO^v) produced in the photolytically initiated reaction: $O + CS \rightarrow CO^v + S$. Gain measurements at the CO_2 laser frequencies are also reported. (Elect. Electron. Abstr.)

32872 LINE WIDTH OF A TRAVELLING WAVE COMBINATIONAL LASER EXCITED BY NONMONOCHROMATIC RADIATION. Pasmanik, G. A.; Sandler, M. S. Zh. Eksp. Teor. Fiz.; 66: No. 1, 74-80(Jan 1974). (In Russian and English).

A theory is developed of the line width of a combinational laser excited by nonmonochromatic pumping radiation with a spectral width much smaller than the line width of spontaneous scattering. It is shown that the line width is determined by the additive contribution of two terms, one of which is related to the nonmonochromaticity of the pumping and the other to spontaneous and thermal noise of the medium. The contribution of the two factors near and far away from the excitation threshold of the combinational laser are discussed. (Elect. Electron. Abstr.)

32873 CHEMISTRY IN LASERS. VIII. Acousto-Optic Modulation in Electrochemiluminescence Lasers. Keszthelyi, C. P. (Louisiana State Univ., Baton Rouge). Spectrosc. Lett.; 8: No. 1, 25-36(1975).

The successful generation of electronically excited states of many laser dyes by electrochemical means (ECL or electrogenerated chemiluminescence) led to experimental inquiries aimed at producing population inversion and laser action in these systems. The electrode is examined in terms of its adverse properties; among those discussed are reflectivity, quenching of ions and excited states, and acoustic disturbance patterns set up during the most commonly used pulsed ECL. This last problem is amenable to investigation by introducing electrodes into conventional optically pumped dye lasers, theoretically treated as a form of acousto-optic modulation. (auth)

32874 NEGATIVE ION LASERS. Golden, D. E.; Ormonde, S. (Univ. of Nebraska, Lincoln). Appl. Phys. Lett.; 24: No. 12, 618-629(15 Jun 1974).

An analysis based on detailed balance arguments is presented to show that a maximum in an electron excitation cross-section resulting from a very-short-lived negative ion resonance (10^{-14}–10^{-16} S), the de-excitation cross-section may be much smaller than the cross-section for excitation. It is proposed that population intensity and laser action may be achieved or enhanced in pure gas lasers by electron bombardment at negative ion resonance energies. (Elect. Electron. Abstr.)

32875 ION-IMPLANTED GaAs INJECTION LASER. Barnoski, M. K.; Hunsperger, R. G.; Lee, A. (Hughes Research Labs., Malibu, CA). Appl. Phys. Lett.; 24: No. 12, 627-628 (15 Jun 1974).

Using a substrate material of single-crystal (100) n-type GaAs doped with Te to 1×10^8 cm^{-3}, a p-type layer is formed by implanting Zn at an ion dose of $\sim 10^{16}$ ions cm^{-2} with an implant energy of 20 keV. The device is then encapsulated in SiO_2 to protect it during a 3 h annealing treatment. The SiO_2 is removed and metal contacts are made. The threshold current density is 2×10^3 A cm^{-2} for devices at 77°K. (Elect. Electron. Abstr.)

32876 CW DYE LASER EMISSION SPANNING THE VISIBLE SPECTRUM. Yarborough, J. M. (Coherent Radiation, Palo Alto, CA). Appl. Phys. Lett.; 24: No. 12, 629-630(15 Jun 1974).

Eighteen dye materials were used successfully in a laser. The experimental arrangement is described. For several dyes this

is the first reported observation of cw laser action. By means of a suitable selection of dyes the whole of the visible spectrum may be covered. (Elect. Electron. Abstr.)

32877 CHEMISTRY IN LASERS. I. The Role of the Stokes 0-0 LOSS. Keszthelyi, C. P. (Louisiana State Univ., Baton Rouge). Spectrosc. Lett.; 7: No. 1, 19-25(1974).

The molecular states in a dye laser are compared to those in the same solution under ordinary fluorescence conditions. Significant differences are found to exist which are readily apparent in case of molecules whose normal fluorescence is characterized by a sizeable Stokes 0-0 loss. Such differences are traced to the invalidity of the Born–Oppenheimer separation approximation for these molecules when the excited state lifetimes are greatly altered as in dye lasers at high photon density. Representation of this particular type of Stokes shift requires an extension of the usual model based on only two hypersurfaces, namely, a time-ordered sequence of quantum states. (Elect. Electron Abstr.)

32878 CHEMISTRY IN LASERS. II. Contribution From Precursor States: A Comparison of the Time Evolution of Electronically Excited States Under Spontaneous and Stimulated Emission Conditions. Keszthelyi, C. P. (Louisiana State Univ., Baton Rouge). Spectrosc. Lett.; 7: No. 1, 27-32(1974).

The relative importance of the time-ordered sequence of precursor states is examined; their contribution to the ensemble is negligible for spontaneous emission, but under stimulated emission conditions at high photon density the dominant terms in the sequence, determining the ensemble properties, are different from the Franck–Condon relaxed state. The "chirp" of a traveling wave laser is shown to be related to time-resolved spectroscopic measurements. (Elect. Electron. Abstr.)

32879 MODE LOCKING DYNAMICS OF HOMOGENEOUSLY BROADENED LASERS. Barnes, N. P. (Martin Marietta Aerospace, Orlando, FL). J. Appl. Phys.; 45: No. 3, 1291-1297(Mar 1974).

A theoretical study of the mode-locked homogeneously broadened laser is presented for both amplitude and frequency modulation. The time development of a Gaussian laser pulse based on the equations of Kuizenga and Siegman is given both with and without finite detuning. The required modulation index necessary to achieve mode locking is estimated for both amplitude and frequency modulation. Numerical values for the Nd:YAG lasers are found to illustrate the theory. (Elect. Electron. Abstr.)

32880 LOW-CURRENT-DENSITY LED-PUMPED Nd:YAG LASER USING A SOLID CYLINDRICAL REFLECTOR. Farmer, G. I.; Kiang, Y. C. (IBM Corp., Gaithersburg, MD). J. Appl. Phys.; 45: No. 3, 1356-1371(Mar 1974).

The design and operation of an improved semiconductor-diode-pumped neodymium-doped yttrium aluminium garnet laser is described. The optical pumping is produced by GaAlAs light emitting diodes, which have a lifetime of over 8000 h at the operating currents. An array of 20 diodes are connected in series and arranged with their emitting surfaces in a straight line. The optical coupling to the cylindrical laser rod is via a solid-glass half cylinder reflector. An analysis of the pumping efficiency of the system is given. A maximum cw output power of 27 mW at a current density of 207 A/cm^2 was achieved which is well below the theoretical value but much higher than with a conventional metal reflector. (Elect. Electron. Abstr.)

32881 HIGH cw OUTPUT POWER IN STRIPE-GEOMETRY PbS DIODE LASERS. Ralston, R. W.; Walpole, J. N.; Calawa, A. R.; Harman, T. C.; McVittie, J. P. (Massachusetts Inst. of Tech., Lexington). J. Appl. Phys.; 45: No. 3, 1323-1325(Mar 1974).

A number of recent advances in laser technology have enabled an improved PbS laser to be constructed. The fabrication of a stripe-geometry PbS diode laser with a maximum double ended cw output power of about 350 mW is described. An external quantum efficiency as high as 27% was obtained. The dominant mode has more than ten times the strength of any other mode and accounts for 60% of the total output power. (Elect. Electron. Abstr.)

32882 BEHAVIOR OF ABOVE-GAP NN PAIR STATES IN RADIATIVE RECOMBINATION IN $GaAs_{1-x}P_x:N^+$ (x = 0.24, 77K). Lee, M. H. (Univ. of Illinois, Urbana); Campbell, J. C.; Holonyak, N. Jr.; Goves, W. O.; Craford, M. G. J. Appl. Phys.; 45: No. 4, 1775-1778(Apr 1974).

The threshold energy of laser action at 77K has been studied for Te doped (10^{19} cm^{-3}) and N doped (>10^{19} cm^{-3}) vapor phase epitaxial $GaAs_{1-x}P_x$ (x = 0.24). Without N, the laser energy is 60 MeV above E_g while N^+ doped samples have energies slightly less than E_g and also less intensity. With Zn doping, in addition making the sample p-type the laser operates at a still lower threshold. This is due to the removal of the built in electron supply from the NN pair states. It is also shown that N impurities do not damage the crystal. (Elect. Electron. Abstr.)

32883 HIGH-POWER 2- TO 6-μm WINDOW MATERIAL FIGURES OF MERIT WITH EDGE COOLING AND SURFACE ABSORPTION INCLUDED. Sparks, M. (Xonics Inc., Van Nuys, CA); Chow, H. C. J. Appl. Phys.; 45: No. 4, 1510-1517(Apr 1974).

A figure of merit has been defined and calculated for a large number of materials suitable for use as windows in the infrared. The basic consideration is the total power which is transmitted and whether edge or face cooling is used. The results show that large diameter windows should be face cooled and small diameter edge cooled. The alkaline earth fluorides have the largest figures of merit for large diameter windows and Si, BaF_2 and GaAs have largest figures of merit for small diameters. The results are expressed in both tabular and graphical form for 15 different materials. (Elect. Electron. Abstr.)

32884 OPTICALLY PUMPED GROWN GaAs MESA SURFACE LASER. Blum, F. A.; Lawley, K. L.; Scott, W. C.; Holton, W. C. (Texas Instruments Inc., Dallas). Appl. Phys. Lett.; 24: No. 9, 430-432(1 May 1974).

Using a method of selective GaAs vapor phase epitaxy in which growth on a substrate is limited to areas exposed as holes in an oxide mask, mesa structures of the material were grown and the vertical as-grown crystalline facets were able to provide the optical feedback. Optical pumping using a doubled Nd:YAG laser working at 0.532μm led to laser oscillations from the mesa laser. (Elect. Electron. Abstr.)

32885 THRESHOLD REDUCTION BY THE ADDITION OF PHOSPHORUS TO THE TERNARY LAYERS OF DOUBLE-HETEROSTRUCTURE GaAs LASERS. Dyment, J. C.; Nash, F. R.; Hwang, C. J.; Rozgonyi, G. A.; Hartman, R. L.; Marcos, H. M.; Haszko, S. E. (Bell Labs., Murray Hill, NJ). Appl. Phys. Lett.; 24: No. 10, 481-484(15 May 1974).

The addition of P leads to a reduction in optical scattering loss and thus to a considerable reduction in lasing current threshold and to an increase in differential quantum efficiency. (Elect. Electron. Abstr.)

32886 CURRENT DEPENDENCE OF SPONTANEOUS CARRIER LIFETIMES IN $GaAs-Ga_{1-x}Al_xAs$ DOUBLE-HETEROSTRUCTURE LASERS. Namizaki, H.; Kan, H.; Ishii, M.; Ito, A. (Mitsubishi Electric Corp., Itami, Japan). Appl. Phys. Lett.; 24: No. 10, 486-487(15 May 1974).

Four-layer-wafers were examined and the spontaneous lifetime of injected carriers was investigated as a function of injection level and found to be proportional to J_{th}^{-5}, J_{th} being the current density of the current pulse at the lasing threshold, for lasers containing 2×10^{17} cm^{-3} Si in the active region. The derived recombination constant agrees well with values estimated for band-to-band transitions. (Elect. Electron. Abstr.)

32887 RECOMBINATION WITHOUT K-SELECTION RULES IN DENSE ELECTRON-HOLE PLASMAS IN HIGH-PURITY GaAs LASERS. Gobel, G. (Univ., Stuttgart). Appl. Phys. Lett.; 24: No. 10, 492-494(15 May 1974).

The validity of the k-selection rule for the electron-hole plasma (EHP) band-to-band transition in pure GaAs is discussed. Using a very pure GaAs crystal at 2K, the emission spectra exhibit a new intense line at high optical pumping levels arising from band-to-band recombination in an EHP. Fitting experimental data to calculated line-shape curves shows that k-selection rules are not conserved in the recombination process. (Elec. Electron. Abstr.)

32888 ANALYTIC SOLUTION OF KINETIC RATE EQUATIONS FOR HF CHEMICAL LASER. Hunter, A. M. II. (Air Force Weapons Lab., Kirtland AFB, NM). Appl. Phys. Lett.; 24: No. 11, 543-545(1 Jun 1974).

The chemical reaction F + H_2 has been analyzed for the population of individual HF vibrational levels starting from the species rate equations. Terms included for the calculation of a given vibrational level are direct chemical pumping, cascading from all higher levels, and deactivation. For well-diluted gas mixtures the analytical and numerical solutions for the species densities show very close agreement. (Elect. Electron. Abstr.)

32889 POSSIBILITY OF A DISTRIBUTED-FEEDBACK X-RAY LASER. Fisher, R. A. (Univ. of California, Livermore). Appl. Phys. Lett.; 24: No. 12, 598-599(15 Jun 1974).

A scheme is proposed for using a distributed feedback design which incorporates the reflectron and the active material as one piece. The cavity mirror structure is provided by internal Bragg scattering which is distributed throughout the crystal medium. (Elect. Electron. Abstr.)

32890 Nd-GLASS LASER WITH THREE-DIMENSIONAL OPTICAL WAVEGUIDE. Saruwatari, M.; Izawa, T. (Nippon Telegraph and Telephone Public Corp., Tokyo). Appl. Phys. Lett.; 24: No. 12, 603-605(15 Jun 1974).

Structural details and experimental results are given for a three-dimensional Nd:glass waveguide showing room-temperature laser action. Double-diffusion and ion migration processes were used for the waveguide fabrication. A Nd:glass laser 4mm in length was end-pumped at 590 nm with a pulsed Rhodamine 6G dye laser. The threshold power for the 3D waveguide laser was 18μJ, about one half of the power required for a conventional Nd:glass laser, and agrees with design calculations. (Elect. Electron. Abstr.)

32891 PULSED HF CHEMICAL LASER LINE WIDTH MEASUREMENTS USING TIME-RESOLVABLE BLEACHABLE ABSORPTION OF HF GAS. Peterson, L. M.; Arnold, C. B.; Lindquist, G. H. (Environmental Research Inst. of Michigan, Ann Arbor). Appl. Phys. Lett.; 24: No. 12, 615-617(15 Jun 1974).

The spectral line-width of an infrared laser has been difficult to measure because of pulse-to-pulse shifts in laser frequency which preclude the use of Fabry-Perot interferometry. The linewidth at 2.7 μm of a transverse discharge pulsed HF chemical laser is measured by using the saturable absorption of low-pressure HF gas in an external cell, and found to be 10^{-4} cm^{-1}, very much less than the Doppler spectral width. It was possible to observe heterodyne heating between two HF lasers and the pulse-to-pulse frequency shift was noted. (Elect. Electron. Abstr.)

32892 LOW THRESHOLD COAXIAL N_2 LASER WITH A RESONATOR. Fischer, H.; Girnus, R.; Ruhl, F. (Technische Hochschule, Darmstadt, Ger.). Appl. Opt.; 13: No. 8, 1759-1760 (Aug 1974).

Construction and performance details are given. Minimum threshold reported is 3.3 kV. With a pulse of 18 kV the maximum power output is 140 kW at 0.35% efficiency. (Elect. Electron. Abstr.)

32893 APPARATUS FOR THE MEASUREMENT OF OPTICAL ABSORPTIVITY IN LASER MIRRORS. Hoffman, R. A. (Westinghouse Research Labs., Pittsburgh). Appl. Opt.; 13: No. 6, 1405-1411(Jun 1974).

An equilibrium calorimetric method is described for measuring the absorptivity in laser mirrors by using electrical calibration. Results using a 15-W CO_2 laser are reported. The minimum cw laser power required is about 0.5 W. Absorptivities of 0.01 can be measured with an accuracy ≤1.4% and a systematic error ≤1.6%. (Elect. Electron. Abstr.)

32894 SINGLE-MODE NITROGEN-PUMPED TUNABLE DYE RING-LASER. Zaraga, F. (Politecnico, Milan). Appl. Phys.; 4: No. 1, 87-88(Jun 1974).

The laser cavity is made with prisms. Oscillation in single transverse and longitudinal mode was easily obtained. (Elect. Electron. Abstr.)

32895 INFLUENCE OF AXIAL MAGNETIC FIELDS ON HIGH-POWER ArII-LASERS. Banse, K.; Luthi, H. R.; Seelig, W. H. (Univ., Bern). Appl. Phys.; 4: No. 2, 141-145(Jul 1974). (In German).

The influence of axial magnetic fields on ion-laser discharges of large diameter (tube radius R = 0.6 cm) has been investigated. At modest power levels (jR < 50 A/cm, j: current density) laser output could be increased by about a factor of 2. The optimum magnetic field B_z was found to follow the relation: B_zR = const. ≃ 150 [Gem]. At high power levels (jR > 150 A/cm) axial magnetic fields cannot increase the laser output. (Elect. Electron. Abstr.)

32896 BOUNDARY CONDITIONS IN LASER OSCILLATORS WITH SPATIAL DISPERSION. Dekker, H. (TNO, The Hague). Appl. Phys.; 4: No. 2, 105-107(Jul 1974).

From the stationary solution of the Fokker-Planck equation for a laser oscillator exhibiting spatial dispersion, presented in a previous paper, the equation for the most probable field configuration is derived. An additional boundary condition is found. (Elect. Electron. Abstr.)

32897 ANALYSIS OF THE EMERGING BEAM OF A MULTIMODE LASER. Belanger, P. A. (Univ. Laval, Quebec). Can. J. Phys.; 52: No. 13, 1189-1194(1 Jul 1974).

A theory is presented that describes the transverse distribution of a multimode laser beam. The fundamental hypothesis of the theory is an equal partition of energy between each mode (hyperspheroidal functions) of the resonator. It is shown that the theory is applicable for high gain lasers with large Fresnel numbers. (Elect. Electron. Abstr.)

32898 METHODS FOR THE DETERMINATION OF THE PARAMETERS OF A YTTRIUM ALUMINUM GARNET CRYSTAL AND INVESTIGATION OF THE INFLUENCE OF THESE PARAMETERS ON THE LASER RADIATION CHARACTERISTICS. Mikaelyan, A. L.; Gardash'yan, V. M.; D'yachenko, V. V.; Filatov, A. N.; Tsarev, P. P. Sov. J. Quantum Electron.; 3: No. 4, 284-287(1974).

Translated from Kvantovaya Elekron. (Moscow); 3: No. 4, 13-18(1974).

The technique of screening a portion of the laser rod under conditions of saturated gain and very small output coupling is shown to yield a simple expression for the crystal losses which is independent of rod dimensions, lateral surface treatment or the pumping system. The product of threshold energy and maximum efficiency of free oscillation is a simple function of the concentration of active centers in the rod and can be used to predict Q-switching performance. Experimental demonstrations of the validity of the theory are given. (Elect. Electron. Abstr.)

32899 NEW DYES FOR PASSIVE SWITCHES IN RUBY LASERS. Klose, E.; Dahne, S.; Durr, H. Sov. J. Quantum Electron.; 3: No. 4, 279-283(1974).

Translated from Kvantovaya Elekron. (Moscow); 3: No. 4, 5-12 (1974).

Two groups of polymethine dyes suitable for passive switches in ruby lasers were synthesized and studied: (1) cation cyanines; (2) electron-neutral cyclobutenediylium dyes of the merocyanine type. Absorption spectra, cross-section data and solvent induced spectral shifts (solvatochromism) are summarized. Comparative performance data obtained for the dyes under typical conditions of use are presented. (Elect. Electron. Abstr.)

32900 RECOMBINATION LASER BASED ON ELECTRON TRANSITIONS IN DIATOMIC MOLECULES. Biryukov, A. S.; Prokhorov, A. M.; Shelepin, L. A.; Shirokov, N. N. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 67: No. 6, 2064-2068(Dec 1974). (In Russian).

General conditions in the visible region are considered for electron transitions of diatomic molecules occurring on recombination of the atoms. The mechanism of inversion formation is analyzed for the O_2 molecule and the amplification factor for the $A^3\Sigma_u^+ \rightarrow X^3\Sigma_g^-$ (λ = 4881 Å) transition is estimated. The feasibility of generation at other wavelengths is briefly discussed. (auth)

32901 PLASMA LASERS INVOLVING MOLECULES WITH A DISSOCIATIVE GROUND STATE. Gudzenko, L. I.; Lakoba, I. S.; Yakovlenko, S. I. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 67: No. 6, 2022-2034(Dec 1974). (In Russian).

A theory of plasma (recombination) lasers is developed for the case of amplification based on transition of dimer molecules to the ground dissociative electron state. Conditions of predominance of photodissociative transitions over the converse photoassociative transitions are considered as well as the kinetics of population of the upper working state under recombination conditions, conditions for generation in post illumination and on quasistationary production of a supercooled (recombining) plasma. Results are discussed of experiments with plasma lasers involving molecules with an uncoupled ground state. (auth)

32902 KINETIC THEORY OF GENERATION OF A STRONG FIELD IN SEMICONDUCTING LASERS. Galitskii, V. M.; Elesin, V. F. (Moscow Engineering-Physics Inst.). Zh. Eksp. Teor. Fiz.; 68: No. 1, 216-222(Jan 1975). (In Russian).

An equation set describing the generation of a strong ($\lambda_T \gg 1$) electromagnetic field by a semiconductor laser was investigated. Kinetic equations for quasiparticles, which are electrons interacting with the generated field, are employed in the set. A dependence of the field strength on pumping current is derived. It is shown that with increase of pumping the dependence becomes nonlinear, there being an upper limit for the generator field strength. (auth)

32903 RAPID ACOUSTOOPTIC TUNING OF A DYE LASER. Hutcheson, L. D.; Hughes, R. S. (Naval Weapons Center, China Lake, CA). Appl. Opt.; 13: No. 6, 1395-1398(Jun 1974).

An acoustooptic deflector (TeO_2) is located in the optical cavity formed by a mirror and a diffraction grating. The deflector has a bandwidth of 50 MHz centered at 100 MHz and by varying the frequency applied to the deflector the intracavity laser beam is scanned across the diffraction grating to tune the laser. (Elect. Electron. Abstr.)

32904 ELECTRONICALLY SCANNED WAVEGUIDE LASER ARRAYS. Corcoran, V. J.; Crabbe, I. A. (Martin Marietta Corp., Orlando, FL). Appl. Opt.; 13: No. 8, 1755-1757(Aug 1974).

An electrooptic phase modulator placed in front of each laser of an array of waveguide lasers to adjust the phase of one laser

relative to another is proposed. The output power of such a scanned array may be competitive with a gas dynamic or a chemical laser. (Elect. Electron. Abstr.)

32905 SMALL-SIGNAL GAIN MEASUREMENTS AND VIBRATIONAL DISTRIBUTION IN CO. Brechignac, P. (CNRS, Cachan, France); Martin, J. P.; Taieb, G. IEEE J. Quant. Electron.; QE-10: No. 10, 797-802(Oct 1974).

Small-signal gain measurements on a large number of vibrational-rotational lines in a CO-laser plasma have led to the vibrational distribution from the v = 2 to v = 31 level. The relative influence of V-V and V-T relaxation processes is discussed. (Elect. Electron. Abstr.)

32906 0.2-GW PULSED H_2F_2 CHEMICAL LASER INITIATED BY AN ELECTRON BEAM. Greiner, N. R.; Blair, L. S.; Bird, P. F. (Los Alamos Scientific Lab., NM). IEEE J. Quant. Electron.; QE-10: No. 9, 616-617(Sep 1974).

Peak powers of 0.2 GW were obtained in 12-J pulses 60-ns full width at half maximum (FWHM) from a room-temperature atmospheric pressure mixture of H_2 and F_2 initiated with an electron beam. The chemical efficiency was 0.25% and the electrical efficiency was ~100%. (Elect. Electron. Abstr.)

32907 HIGH-REPETITION-RATE Nd:GLASS LASER MODE LOCKED BY A SATURABLE ABSORBER. Fan, B.; Leskovar, B.; Lo, C. C.; Morton, G. A.; Gustafson, T. K. (Univ. of California, Berkeley). IEEE J. Quant. Electron.; QE-10: No. 9, 654-655 (Sep 1974).

A passively mode-locked Nd:glass laser which generates single pulses of 6-ps duration at a rate of 5/s is reported. (Elect. Electron. Abstr.)

32908 PROBE MEASUREMENTS OF Ar^+-LASER PLASMA PARAMETERS. Kitaeva, V. F.; Osipov, Yu. I.; Sobolev, N. N., Shelekhov, A. L.; Agheev, V. P. (Lebedev Inst. of Physics, Moscow). IEEE J. Quant. Electron.; QE-10: No. 10, 803-809 (Oct 1974).

The results of local investigations of Ar^+-laser plasma parameters by a new pulsed single-probe method are presented. The experiments were carried out in a 10-mm-bore tube at discharge currents of 60 to 80 A and argon pressure of 0.2 to 1 atm. (Elect. Electron. Abstr.)

32909 ANALYTICAL CONSIDERATIONS OF BRAGG COUPLING COEFFICIENTS AND DISTRIBUTED-FEEDBACK X-RAY LASERS IN SINGLE CRYSTALS. Yariu, A. (California Inst. of Tech., Pasadena). Appl. Phys. Lett.; 25: No. 2, 105-107(15 Jul 1974).

Expressions are derived for the coupling coefficients which characterize Bragg x-ray scattering in single crystals and are used to calculate the threshold gain of a distributed feed-back laser of a novel construction. It is suggested that the device proposed could be made using zinc-blende structure crystals such as GaP, or a mixed crystal system, $Ga_{1-x}A_xP$ or $GaP_{1-x}B_x$ where A and B are Group III and V atoms respectively. (Elect. Electron. Abstr.)

32910 POLYCHROMATIC PULSED DYE LASER. Nakashima, M.; Sousa, J. A. (Army Natick Labs., MA). Spectrosc. Lett.; 7: No. 1, 15-17(1974).

A device that generates a laser pulse with a number of wavelengths not only spacially superimposed but simultaneously is reported. The idea for this device was conceived in the course of a study of the efficiency of laser dye solutions. It was found that only a fraction of energy from a single pulse of a 100 kw nitrogen laser was necessary to pump a dye laser effectively. A fluorometer dye cell 1 cm wide showed laser action when it was exposed to a linearly focused nitrogen laser, 5.5 cm wide. This observation suggested the use of a number of such cells to produce laser beams with many colors from a single pulse of the nitrogen laser. (Elect. Electron. Abstr.)

32911 EFFECT OF DOPING ON DEGRADATION OF GaAs–$Al_xGa_{1-x}As$ INJECTION LASERS. Mullin, P. G.; Blum, J.; Shik, K. K.; Smith, A. W.; Woolhouse, G. R. (IBM Watson Research Center, Yorktown Heights, NY). Appl. Phys. Lett.; 24: No. 12, 595-597(15 Jun 1974).

The limited life (10 to 100 h continuous operation) with noncatastrophic degradation of the performance of GaAs–$Ga_{1-x}Al_xAs$ double heterostructure lasers may be due to the active layer doping impurity and this has been studied using pulsed excitation. Compensated p-type impurities give the slowest degradation and n-type impurities the fastest. The results agree with a model based on arsenic vacancy migration and the formation of arsenic vacancy-acceptor complexes. (Elect. Electron. Abstr.)

32912 EXPERIMENTAL STUDY OF THE LINEAR GROWTH REGION OF ULTRA-SHORT-PULSE GENERATION IN A MODE-LOCKED Nd:GLASS LASER. Sam, C. L. (Brown Univ., Providence). Appl. Phys. Lett.; 24: No. 12, 631-633(15 Jun 1974).

The duration τ_1 of the linear growth stage of ultrashort pulse (USP) generation was measured experimentally using a novel arrangement in which τ_1 is related to the final pulse width of the USP train after the non-linear development. A linear relation between USP pulsewidth and τ_1 is confirmed and τ_1 is of order 100 μsec. The long τ_1 may be associated with some precursor spikes which occur in most shots. (Elect. Electron. Abstr.)

32913 SATURATION BEHAVIOR OF THE OPTICAL GAIN IN GaAs INJECTION LASERS. Lang, R. (Nippon Electric Co. Ltd., Kawasaki, Japan). IEEE J. Quant. Electron.; QE-10: No. 10, 825-826(Oct 1974).

A recent analysis of the saturation behavior of the optical gain in semiconductor lasers has predicted a strong spectral hole-burning effect. With an improved treatment of the intraband relaxation in the analysis the effect disappears entirely. (Elect. Electron. Abstr.)

32914 BUFFER GAS EFFECTS IN A RAPIDLY PULSED COPPER VAPOR LASER. Ferrar, C. M. (United Aircraft Research Labs., East Hartford, CT). IEEE J. Quant. Electron.; QE-10: No. 9, 655-657(Sep 1974).

In double-pulse experiments with a small copper vapor laser, the choice of buffer gas significantly affected several laser characteristics, including the maximum practical pulse repetition rate. Of the gases tested, neon exhibited the best overall performance, and showed no pulse degradation for pulse intervals as short as 50 μs. (Elect. Electron. Abstr.)

32915 RADIATION FIELDS OF GaAs–(AlGa)As INJECTION LASERS. Butler, J. K.; Zoroofchi, J. (Southern Methodist Univ., Dallas). IEEE J. Quant. Electron.; QE-10: No. 10, 809-815(Oct 1974).

Theoretical radiation patterns from a multilayer model of a dielectric waveguide are fitted to single model experimental profiles of three symmetrical double-heterojunction cavities to test the adequacy of the model and study the effect of the dielectric parameters on the beam pattern. The radiation from the normal TE modes is approximated by plane waves, while for the TM modes it is given by boundary value solutions of the Maxwell equations. The adequacy of the theory is shown by a faithfulness of the fit out to large beam angles and low intensities, and the agreement of the adjusted cavity parameters to the experimental values. Small charges in either the cavity thickness or the dielectric constant of the internal n-type region have similar first order effects on the angular position of the minima in the profile as well as in the amplitude of the sidelobes. Depths of the minima decrease with departures of the structure from planarity. Pattern distortion from mode coupling at the interfaces and facets is not observed. (Elect. Electron. Abstr.)

32916 FLASHLAMP-PUMPED YAG:Nd^{+3} LASER ACTION AT KILOHERTZ RATES. Corcoran, V. J.; McMillan, R. W.; Barnoske, S. K. (Martin Marietta Aerospace, Orlando, FL). IEEE J. Quant. Electron.; QE-10: No. 8, 618-620(Aug 1974).

Laser action at high repetition rates with flashlamp pumping has been achieved in a YAG:Nd^{3+} laser rod. With the resonant charging techniques used in the experiments, the repetition rate is limited by the heating of the laser rod. (Elect. Electron. Abstr.)

32917 STABILITY OF AN INTRACAVITY FREQUENCY-DOUBLED Nd:YAG LASER. Kennedy, C. J.; Barry, J. D. (Wright-Patterson Air Force Base, Cleveland). IEEE J. Quant. Electron.; QE-10: No. 8, 596-599(Aug 1974).

Single-mode rate equations are solved in the small-signal limit to determine the oscillation frequency and decay constant for relaxation oscillations in an intracavity frequency-doubled Nd:YAG laser. It is found that improved stability is noted for nonlinear coupling constants greater than 10^{-5}. Eventually, cavity perturbations become critically damped with increased coupling, and oscillatory behavior disappears. (Elect. Electron. Abstr.)

32918 CHARACTERISTICS OF AN Nd:CaLaSOAP MODE-LOCKED OSCILLATOR. Eckardt, R. C.; DeRosa, J. L.; Letellier, J. P. (Naval Research Lab., Washington, DC). IEEE J. Quant. Electron.; QE-10: No. 8, 620-622(Aug 1974).

Neodymium doped calcium lanthanum silicate oxyapatite (Nd:CaLaSOAP) has properties intermediate between Nd:YAG and Nd:glass that make it desirable for use as a pulsed-mode-locked oscillator at 1.06 μ. Time resolved spectroscopy, high speed image converter streak recordings, and two-photon fluorescence pulse duration measurements were used to investigate the output of such a laser. Pulse durations from 5 to 15 ps were observed under different operating conditions. (Elect. Electron. Abstr.)

32919 MODE STABILITY OF LASERS AND PERIODIC OPTICAL SYSTEMS. Casperson, L. W. (Univ. of California,

Los Angeles). IEEE J. Quant. Electron.; QE-10: No. 8, 629-634(Sep 1974).

The concept of mode stability is considered in detail and a procedure is developed for determining the stability of laser resonators and optical waveguides containing arbitrary lens elements. It is found that under some conditions the addition of a laser medium with a gain profile makes oscillation or propagation impossible in an otherwise stable system. A new formalism is described for the propagation of off-axis modes. (Elect. Electron. Abstr.)

32920 EXPERIMENTS ON IMPROVED UNSTABLE MODE PROFILES BY APERTURE SHAPING. Maunders, E. A. (Northrop Research and Technological Center, Hawthorne, CA); McAllister, G. L.; Steier, W. H. IEEE J. Quant. Electron.; QE-10: No. 10, 821-822(Oct 1974).

A 3.5-μm He-Xe laser has been used to experimentally observe improvements in mode intensity profiles by shaping the cavity aperture. Significant improvements over circular apertures were achieved with elliptical and serrated mirror shapes. (Elect. Electron. Abstr.)

32921 METHODS FOR OPTIMIZING THE BEAM SHAPE IN A FOCUSED COHERENT OPTICAL SYSTEM. Aagard, R. L. (Honeywell Inc., Bloomington, MN). Appl. Opt.; 13: No. 7, 1633-1638(Jul 1974).

Three methods by which the shape of a laser beam may be altered for optical memory purposes are discussed. Defocusing by means of a birefringent lens with a polarization modulator is analyzed. A method by which the beam diameter may be changed is described. Thirdly, the on-axis intensity can be adjusted by controlling the radius of a phase filter. Experimental results are given and it is concluded that substantial improvement can be gained in the readout efficiency by changing the beamshape or the spot size between writing and reading. The laser should operate in the doughnut mode for the easiest attainment of optimum write/read conditions. (Elect. Electron. Abstr.)

32922 LASER MODE LOCKING WITH A GLASS FILTER. Selden, A. C. (UKAEA, Abingdon, Eng.). Appl. Opt.; 13: No. 7, 1555(Jul 1974).

The paper notes a similarity between Winer's result on mode locking and modulation observed by Magyar and Selden. (Elect. Electron. Abstr.)

32923 UNIFORM CONTINUOUS DISCHARGES AND CO_2-LASER ACTION AT ATMOSPHERIC PRESSURE BY PLASMA INJECTION. McLeary, R.; Beckwith, P. J.; Gibbs, W. E. K. (Dept. of Supply, Maribyrnong, Australia). IEEE J. Quant. Electron.; QE-10: No. 9, 649-651(Sep 1974).

Injection of ionized gas is used to obtain uniform continuous discharges in CO_2-laser gas mixtures at atmospheric pressure. Power input densities of up to 150 kW/l have been obtained in mixtures of $CO_2/N_2/He$ and $CO_2/N_2/H_2$. Laser action has been obtained in a small device under conditions where the gain coefficient was 0.1 m^{-1}. (Elect. Electron. Abstr.)

32924 FREQUENCY CHARACTERISTICS OF AN ANNULAR HELIUM–NEON LASER. Markelov, V. A. (Scientific Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 27: No. 11, 1642-1648(1974). (In Russian).

A study of the frequency characteristics of an annular helium–neon laser operating in a single-mode situation on a 0.63 micrometer wavelength is described. The influence of the parameters of the resonator and the active medium is evaluated for any ratio of neon isotopes. Any correction must depend on the generation frequency, however this dependence is a weak one and change in the coefficients of back reflections during frequency tuning of the resonator is a much more significant factor. (JPRS)

32925 $In_{1-x}Ga_xP$ ($x \sim 0.63$) YELLOW INJECTION LASER (λ = 5900 A, 77°K), PRODUCED BY THE METHOD OF LIQUID EPITAXY. Hitchens, W. R.; Holonyak, N.; Lee, M. N.; Campbell, I. C. (Univ. of Illinois, Urbana). Fiz. Tekh. Poluprov.; 8: No. 12, 2418-2424(Dec 1974). (In Russian).

A laser designed on a p-n-junction in $In_{1-x}Ga_xP$, produced by the liquid epitaxy method (77°K, wavelength 5900 A), is described. This method is briefly described at the constant temperature used for synthesis of crystals. The p-n-junctions were produced by successive growing on a substrate of $GaAs_{1-y}P_y$ first a film of $In_{1-x}Ga_xP$ of n-type and then a p-film doped with zinc (without equalizing). During the time of growing the n-type film, the zinc is easily diffused (in lesser concentrations) to the first film, creating a thin equalized active p-type domain. During photoexcitation it was found that recombination radiation is localized in the equalized film and the energy of this radiation is less than the radiation energy corresponding to photoluminescence in the n- and p-domains. Due to the waveguide effect in the active domain and to the influence of the density of the donor zone in the equalized film, this structure is similar in its properties to an isolated heterojunction. It was shown that in spite of the still high threshold current density, semiconductor lasers on a base of the compounds $A^{III}B^{V}$ may operate at $\lambda < 5900$ Å, that is, in the yellow band of the spectrum. It is proven that injection lasers can be created on the base of p-n-junctions in $In_{1-x}Ga_xP$ all the way up to wavelengths on the order of 5650 Å (77°K). (JPRS)

32926 DISTRIBUTED FEEDBACK IN LASERS USING NONSTATIONARY PUMPING: POSSIBLE EMISSION IN THE ULTRAVIOLET BANDWIDTH WITHOUT A RESONATOR. Akhmanov, S. A.; Lvakhov, G. A. Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 7, 470-474(5 Apr 1974). (In Russian).

Some new applications for distributed feedback achieved by space modulation of the amplification in laser systems are examined. A study is made of distributed feedback in gas systems and the transient time of the oscillations and energy loss due to the distributed feedback are determined. The possibility of using distributed feedback in lasers operating in the ultraviolet bandwidth is discussed. (Elect. Electron. Abstr.)

32927 REPRODUCIBILITY OF THE FREQUENCY OF AN He–Ne LASER WITH A METHANE ABSORBING CELL. Bagaev, S. N.; Baklanov, E. V.; Titov, E. A.; Chebotaev, V. P. (Inst. of Physics of Semiconductors, Novosibirsk, USSR). JETP Lett. (USSR) (Engl. Transl.); 20: No. 5, 130-132(5 Sep 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 20: No. 5, 292-296(5 Sep 1974).

Experiments are described on frequency reproducibility and the results of theoretical investigations of the influence of the mhfs on the position of the resonance are presented. Analysis has shown that in certain operating regimes of an He–Ne laser with absorbing cell, the mhfs does not prevent attainment of a reproducibility 10^{-13} to 10^{-14}. (TFD)

32928 REPRODUCIBILITY OF THE FREQUENCY OF A LASER STABILIZED ACCORDING TO THE TRANSITION OF THE ABSORBING GAS. Gnatovskii, A. V.; Belenov, E. M.; Danieleiko, M. V.; Nikitin, V. V.; Fedin, V. P.; Shpak, M. T. Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 368-371(20 Mar 1974). (In Russian).

The power resonances at the centers of the intensifying ω_+ and absorbing ω_- components were obtained together for a helium–neon ring laser with a nonlinear absorption cell. They can be matched with an accuracy of $\sim 10^4$ Hz by changing the pressure in the intensifying medium, which makes it possible to obtain a high reproducibility of the frequency of gas lasers ($\sim 10^{15}$ in terms of the parameter $(\omega_+ - \omega_-)$). (Elect. Electron. Abstr.)

32929 QUASISTATIONARY ATMOSPHERIC PRESSURE CO_2 LASER WITH A SEMI-SELF-MAINTAINED DISCHARGE CONTROLLED BY AN ELECTRON BEAM. Velikhov, E. P.; Zemtsov, Yu. K.; Kovalev, A. S.; Persiantsev, I. G.; Pis'mennii, V. D.; Rakhimov, A. T. Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 6, 364-368(20 Mar 1974). (In Russian).

Quasistationary emission is achieved from an atmospheric pressure CO_2 laser with a semi-self-maintained discharge controlled by an electron beam with a current density of ~50 $\mu A/cm^2$. The calculated and experimentally obtained values for the weak signal amplification factor are given. The peaked nature of the emission is recorded. (Elect. Electron. Abstr.)

32930 GROWTH OF GENERATING POWER IN A RUBY LASER WITH SELF-MODULATING QUALITY. Borisov, V. I.; Lebedev, V. I. Zh. Prikl. Spektrosk.; 20: No. 6, 987-989(Jun 1974). (In Russian).

A photographic method was suggested for the recording of emission intensity in the laser beam over wide ranges of intensity and length of generation. The method was based on the rapid photography of a succession of beams, obtained by the splitting of the laser beam by plane-parallel glass plates. The study showed that giant pulses were spontaneously generated and that the leading front of the pulses were of a nonexponential form. Generation peaks were also found to exist. The data indicated that the laser resonator quality has a substantial effect on the intensity of emission. (Elect. Electron. Abstr.)

32931 SIMULATED EMISSION OF SUBMILLIMETER WAVES BY HYDRAZINE MOLECULES, EXCITED BY A CO_2-LASER. Dyubko, S. F.; Svich, V. A.; Fesenko, L. D. Zh. Prikl. Spektrosk.; 20: No. 4, 718-719(Apr 1974). (In Russian).

The properties of a submillimeter laser are given, using hydrazine vapor excited by a CO_2-laser as the active medium. Such a laser permits at least 26 waves in the 200 μm-1 mm continuum region. The wavelengths, intensity and polarization of the submillimeter emission were measured, and the corresponding pumping lines of the CO_2-laser indicated. (Elect. Electron. Abstr.)

32932 DYNAMICS OF ACTIVE MODE PHASING IN A PULSED LASER. Anikeev, B. V. Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 1, 34-38(5 Jan 1974). (In Russian).

For the first time ultrashort pulses having an energy of the order of the energy of amplification saturation ($6J/cm^{-2}$) were generated directly in a laser. It is shown that it is theoretically possible, with a giant pulse mode, to phase the spectral emission components within the limits of the emission spectrum. The emission spectrum includes frequencies differing greatly from the resonator modes. (Elect. Electron. Abstr.)

32933 IODINE PHOTODISSOCIATION LASER USING COMPOUNDS CONTAINING ATOMS OF THE GROUP V ELEMENTS. Struk, I. I.; Birich, G. N.; Drozd, G. I.; Sorokin, V. N. Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 1, 44-47(5 Jan 1974). (In Russian).

The possible use of compounds containing an iodine atom bound to elements of group V-P-I, As-I, Sb-I-as a working medium for an iodine photodissociation laser is investigated. Emission is achieved with 16 of the compounds of this kind. Certain special features observed in the operation of the laser using the new substances are discussed. (Elect. Electron. Abstr.)

32934 PULSED CO_2 LASER WITH A RADIATION ENERGY OF 150J. Baranov, V. Yu.; Borisov, V. M.; Niz'ev, V. G.; Petryakov, V. M. Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 4, 21-25 (20 Feb 1974). (In Russian).

The construction and parameters of a pulsed CO_2 laser with energy of 150J and a pulse duration of ~100 nsec are described. Problems concerning the stability of the uniform discharge phase are studied. The transient times of instability and arising in molecular gases are measured. (Elect. Electron. Abstr.)

32935 CO_2 LASER OPERATING AT 10.6 μ WITH OPTICAL PUMPING AT 9.6 μ. Balykin, V. I.; Golger, A. L.; Kolomiiskii, Yu. R.; Letokhov, V. S.; Tumanov, O. A. Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 7, 482-485(5 Apr 1974). (In Russian).

For the first time emission was observed using a CO_2 molecule in the 10.6 μ region with optical pumping of the composite oscillating band 02°0 to 00°1 by pulses from a CO_2 laser in the 9.6 μ range. (Elect. Electron. Abstr.)

32936 LASER USING A SOLUTION OF A RHODAMINE 6G IN ETHYL ALCOHOL WITH AN EMISSION ENERGY OF 400J IN THE PULSES. Baltakov, F. N.; Barikhin, B. A.; Sukhanov, L. V. Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 5, 300-302(5 Mar 1974). (In Russian).

Emission was achieved using an alcohol solution of rhodamine 6G in the excitation of a dye by a pulsed coaxial electron tube. The electrical energy supplied to the tube was 50kJ, the emission energy 400J, the halfwidth of the emission pulse 10μsec, and the peak power of the radiation emitted was 40 MW. The angular divergence of the radiation was 3.5×10^{-2} rad and the width of the emission spectrum was 9 nm. (Elect. Electron. Abstr.)

32937 PULSIVE PRISM Q-SWITCHING FOR LASERS. Stamenov, K.; Vasilev, Yu.; Iordanova, Zh.; Pavlov, L. God. Sofii. Univ., Fiz. Fak.; 64-65: 289-293(1970). (In Bulgarian).

A modification of the Q-switch with a rotating prism with a total internal reflection is considered. Continuous rotation of the prism has been replaced by pulsive rotation at a certain angle through a position b with Q-maximum. Several methods of pulsive moving the prism have been investigated, i.e., with gravitational force, with elastic force and with electromagnetic relay. The prism has been found to pass through the position of Q-maximum at an equivalent speed of 7200 rpm and a monopulsive regime of generation with a pulse time of 60 ns and a power of 0.48 MW has been realized. (Elect. Electron. Abstr.)

32938 EXCITATION AND EMISSION IN A PULSED N_2 GAS LASER. Gundel, H.; Ross, W. Ann. Phys. (Leipzig); 31: No. 3, 263-276(1974). (In German).

A theoretical treatment of pulsed nitrogen laser operation is presented. The properties of laser pulses were investigated as functions of various parameters (electric circuit parameters, laser length, gas pressure). Based on this model some conditions are obtained which are necessary for effective laser pulse emission, and the known nitrogen laser devices are discussed. (Elect. Electron. Abstr.)

32939 700 METER LONG VACUUM CAVITY ARGON ION LASER: ITS MODE INTERACTIONS AND MODE LOCKED OPERATION. Tripathi, P. P. La Jolla, San Diego, CA; Univ. of California (1974). 341p. University Microfilms Order No. 75-9490.

Thesis (Ph. D.).

A visible laser, argon ion on the high gain 4880 Å transition, was made to operate in a long optical cavity. A single frequency cw operation was achieved. The laser was also actively amplitude-modulated to produce mode-locked pulses, at a repetition rate of 204 kHz. (TFD)

32940 PRECISION MEASUREMENT OF FRESNEL DRAG IN A RING LASER. Stowell, W. K. Stillwater, OK; Oklahoma State Univ. (1974). 102p. University Microfilms Order No. 75-8899.

Thesis (Ph. D.).

The objective in this study was to make a precision measurement of the drag coefficient of light in a moving, solid medium inside a ring laser cavity at the He-Ne laser line of $\lambda = 0.63300$ μm. This study provides quantitative evidence that leads to an answer to the question as to whether the light dragging phenomenon in a ring laser (closed light path and self-oscillating) is the same as that of the passive light beam (classical drag effect). The intended, overall accuracy (0.2%) of the measurements should lend new information in this regard as well as aid in distinguishing among the viable theoretical models. The ring laser is well suited for this study as it is a differential sensor of anisotropic effects; the drag effect is a particular type of anisotropy. Seventeen curves were plotted using the experimentally obtained data. The slopes of these curves were then used to determine the drag coefficient α_{exp}. The seventeen α_{exp}'s had an average of $\bar{\alpha}_{exp} = 0.5425$ with a standard deviation of $\sigma_{\bar{\alpha}_{exp}} = 0.0004$. The Sagnac effect due to the earth's rotation is well represented in the data such that the experimental value is within 10% of the theoretical value. On consideration of the existing theoretical models one finds that: (a) the Fresnel drag coefficient (without dispersion) is unquestionably rejected, (b) the Laub formulation gives a value of $\alpha_{Lo} = 0.5376$ which differs from $\bar{\alpha}_{exp}$ by more than 12 times the standard deviation of the experimental data. Based on this and the conditions of these experiments the Laub drag coefficient is thus rejected and (c) the Lorentz formulation gives a value of $\alpha_{Lo} = 0.5416$ which differs from $\bar{\alpha}_{exp}$ by approximately 2 times the standard deviation of the experimental data. Based on these experimental results it appears that none of the existing theoretical models account for the actual drag in a ring laser. The contributions to the experimental error are analyzed, and suggestions are made for their reduction. Suggestions are made for measurements to be performed in the infrared frequency range and using liquids. (Diss. Abstr. Int., B)

32941 USE OF RELATIVISTIC ELECTRON BEAMS FOR THE STUDY OF CHEMICAL AND RARE GAS LASER SYSTEMS. Krawetz, B. Davis, CA; Univ. of California (1974). 76p. University Microfilms Order No. 75-8342.

Thesis (Ph. D.).

Chemical ($NF_3 + H_2$) and rare gas molecular (He_2, Kr_2, Ar_2) laser systems are examined. Intense relativistic electron beams are used as a source of initiation and stimulation respectively. For the high gain chemical system, nonlinear amplification and pulse propagation are examined. The experimental result shows all the qualitative features of the theoretical prediction. In addition certain kinetic excitation and deactivation mechanisms are studied through the short stimulation time available with the electron beam. Results obtained from the examination of laser action of the test system compare well with more conventional schemes for kinetic rate data extraction. For rare gas molecular systems, the electron beam provided an excellent tool for studying the energy flow beginning with formation of the diatomic eximer to final decay by spontaneous radiative decay. Laser action in Krypton (Kr_2) is predicted. Symmetry in excitation mechanisms is demonstrated for the rare gases as a class. (Diss. Abstr. Int., B)

32942 EFFECT OF COLLISIONS ON THE MODE CROSSING SIGNALS OF A He-Ne-LASER. Graubner, F.; Hermann, G.; Scharmann, A. (Univ., Giessen, Ger.). Z. Phys.; 269: No. 1, 79-82(1974).

Saturation induced minima of the output power of a He/Ne-laser appear if Zeeman splitting equals the frequency separation. These minima have been investigated as a function of pressure. The results show pressure broadening caused by velocity changing and alignment destroying collisions. In contrast to Lamb-dip measurements the effect of phase changing collisions on collision broadening is negligible. (Elect. Electron. Abstr.)

32943 STUDY OF ENERGY CHARACTERISTICS OF COMPETING TRANSITIONS IN A He-Ne LASER WITH THE ACTIVE MEDIUM PLACED IN A MAGNETIC FIELD. Voitovich, A. P.; Shkadarevich, A. P. Zh. Prikl. Spektrosk.; 20: No. 4, 606-611 (Apr 1974). (In Russian).

The effect of the field on the competing transitions having wavelengths of 1.080 and 1.198 μm was studied in the laser. The dependence of the generating power W on the intensity H of the field was obtained in an isotropic laser and in a laser fitted with a Brewster plate in the resonator. The dependence of W(H) for the

isotropic laser was determined by plasma effects, and in the other system, Zeeman splitting of the amplification contours. Small values of H and W give rise to double optical resonance conditions. The g-factors for the $2p_2$ and $2p_7$ neon levels were determined. Hysteresis was shown to arise when generation changed from one transition to generation on both indicated transitions. (Elect. Electron. Abstr.)

32944 STUDY OF THE SPECTRAL COMPOSITION OF A CO_2-LASER EMISSION DURING MODULATION OF QUALITY. Leshenyuk, N. S.; Orlov, L. N. Zh. Prikl. Spektrosk.; 20: No. 4, 601-605(Apr 1974). (In Russian).

The dependence of spectral composition on the excitation conditions and resonator field formation conditions was studied. Under typical working conditions, in the Q-generation region a large number of vibrational-rotational lines of the P-branch arise due to transitions 00°1 to 10°0 ($\lambda \sim 10.6$ μm) and 00°1 to 02°0 ($\lambda \sim 9.55$ μm). The latter transition occurs about 10^{-6} s after the former and is usually of larger intensity. Changing the excitation conditions and the resonator field enable the spectral emission composition to be changed within certain limits. (Elect. Electron. Abstr.)

32945 DECOMPOSITION INSTABILITY OF VIBRATIONAL RELAXATION IN MOLECULAR GASES [CO_2 LASER CHARACTERISTICS]. Novobrantsev, I. V.; Starostin, A. N. Zh. Prikl. Mekh. Tekh. Fiz.; No. 2, 164-167(1974). (In Russian).

The dynamic characteristics of the CO_2 laser are analyzed, using Gordiets treatment of vibrational relaxation in the molecular gas mixtures. It is shown that at constant pumping rates an oscillatory transfer of energy between different vibrational modes is possible, which may lead to peaking in output of a CO_2 laser. (Elect. Electron. Abstr.)

32946 OPTICAL EFFICIENCIES OF COAXIAL SYSTEMS OF PUMPING LIQUID LASERS. Zhuravleva, I. N.; Kronskii, G. I.; Shcherbakov, A. A. Zh. Prikl. Spektrosk.; 20: No. 6, 981-986 (Jun 1974). (In Russian).

The optical efficiency and energy balance composition of such systems were studied theoretically. The dependence of the efficiency on the absorption parameters and geometrical dimensions of the active medium and the plasma source was analyzed. The obtained results cover the important practical cases, and allow the effective working regions of the pumping system to be determined. (Elect. Electron. Abstr.)

Cryogenic and Superconducting Equipment and Devices

Refer also to abstract 33921.

32947 (AD/A-001027) NOISE IN JOSEPHSON EFFECT mm-WAVE MIXERS. Claassen, J. H.; Taur, Y.; Richards, P. L. (California Univ., Berkeley (USA). Dept. of Physics). 30 Sep 1974. Contract N00014-69-A-0200-1056. 6p. (CONF-740957-32). NTIS $3.25.

From applied superconductivity conference; Oakbrook, Illinois, USA (30 Sep 1974).

It is shown that point contact Josephson junctions can function as millimeter wave heterodyne mixers with conversion gain. The best results achieved thus far show a single sideband conversion gain of 1.3 and a mixer contribution to the system noise temperature of 54 K. Both of these results are approximately 5 times better than the best published figures for cooled Schottky barrier diode mixers operated at the same frequency. (auth)

32948 (AD/A-001028) JOSEPHSON JUNCTIONS AS HETERODYNE DETECTORS. Taur, Y.; Claassen, J. H.; Richards, P. L. (California Univ., Berkeley (USA). Dept. of Physics). Aug 1974. Contract N00014-69-A-0200-1056. 24p. (CONF-740694-2). NTIS $3.25.

From international conference on submillimeter waves and their applications; Atlanta, Georgia, USA (5 Jun 1974).

Heterodyne detection with a point contact Josephson junction was investigated both experimentally and theoretically. The measured performance of the device at 36 GHz is in good agreement with the theory. By operating vanadium point contacts at 1.4°K, the authors have achieved a single side band mixer noise temperature of 54°K with a conversion gain of 1.35 and a signal bandwidth of the order of 1 GHz. From the results one can extrapolate a potentially impressive performance for these devices at submillimeter wavelengths. (GRA)

32949 (AD/A-001030) RELAXATION OSCILLATIONS IN POINT CONTACT JOSEPHSON JUNCTIONS. Taur, Y.; Richards, P. L. (California Univ., Berkeley (USA). Dept. of Physics). Sep 1974. Contract N00014-69-A-0200-1056. 22p. NTIS $3.25.

Negative resistance regions have been observed on the static I_0-V_0 curves of point contact Josephson junctions when dc biased with a low impedance source. An equivalent circuit model has been developed which successfully explains the experimental results in terms of relaxation oscillations. It is also found that such junctions can be operated either as a one-port amplifier for signals at 5 MHz, or as a 36 GHz heterodyne mixer with large conversion gain. (GRA)

32950 (AD/A-001106) EXPERIMENTAL STUDIES OF THE MICROWAVE PROPERTIES OF 8.6 GHz SUPERCONDUCTING NIOBIUM, NIOBIUM-TANTALUM, AND TANTALUM CAVITIES. Lyneis, C. M. (Stanford Univ., Calif. (USA). High-Energy Physics Lab.). Sep 1974. 130p. (HEPL-737). NTIS $5.75.

Thesis.

Measurements on the surface impedance of superconducting niobium, tantalum, and a 30 at% niobium-70 at% tantalum alloy are reported. The measurements were made on x-band mode cavities at a nominal frequency of 8.6 GHz. The surface resistance and the change of surface reactance for the three materials were measured from 1.3°K up to their respective transition temperatures. These data were compared to computer calculations based on the Mattis-Bardeen expressions for the surface resistance and reactance of superconductors. Evidence is also presented concerning the effect of thermal expansion of niobium on the resonant frequency of an X-band cavity as a function of temperature below 2°K. The influence of trapped magnetic flux on the microwave surface resistance and reactance of niobium is also reported. (auth)

32951 (KFK-2052) FUNDAMENTAL ASPECTS FOR CONDUCTOR ARRANGEMENTS WITH HIGH AND VERY SMALL INDUCTANCES AND A TECHNICAL REALIZATION. Koefler, H.; Maurer, W.; Noether, G.; Ulbricht, A. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). Jan 1975. 24p. Dep. NTIS (US Sales Only) $4.25.

The practical application of energy storage by means of magnetic fields became importance in magnet technology with the introduction of superconductivity. A complete unit for storing magnetic energy consists of a storage inductor which is superconductively shortened. For the energy extraction the short circuit must be opened at a certain time. The opening device is called a superconductive switch. The storage inductor must have a large inductance for storing energy as much as possible while the switch must have an inductance as small as possible for fast response of the switch and fast extraction of the energy. In this report, some fundamental aspects for conductor arrangements with high and very small inductances are considered. Based on the formulas for the magnetic energy some restrictions for the performance of such arrangements are discussed. A complete unit for storing magnetic energy has been constructed according to the mentioned restrictions. This device is described in detail. (WHK)

32952 (KFK-2064) CURRENT TRANSFORMATION AND FIELD SCREENING WITH SUPERCONDUCTING COILS. Scherer, M.; Turowski, P. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Experimentelle Kernphysik). Feb 1975. 31p. (In German). Dep. NTIS (US Sales Only) $4.75.

Investigations on the inductive generation of electrical currents in superconducting coils are reported. The induced currents are limited by the I_c, B-curve of the superconductor so that they break-down at certain values of magnetic field; after each breakdown a current is induced again if the field increases continuously. From an examination of the current-field values at the break-down points the I_c, B-curve for the superconducting material can be derived. As a maximum, currents of 4000 A were induced in a coil made of superconducting cable. Inductive screening of a magnetic field by a superconducting coil is correlated with a negative field in the center. (auth)

32953 DYNAMIC STUDIES OF SUPERCONDUCTING THIN FILM BRIDGES. Schmidt, W. D. (Univ., Jena, Ger.). Exp. Tech. Phys.; 22: No. 5, 407-414(1974). (In German).

The switch velocity of thin film bridges (TFB) from the superconducting to the normal state was investigated relative to the electrical and geometrical parameters. The TFB's consist of a layer system (In-Pb-In). Measurements were made with a sampling oscillograph according to the four-terminal method. The rise time t_r is a function of the length l of the TFB and the excess current ratio $m = I/I_c$ (I_c = critical current). Lowest rise times of TFB's with 18 μm length in the order of 8 ns were measured. The experimental results were discussed with a theoretical model qualitatively. (auth)

32954 METHOD OF MAKING SUPERCONDUCTORS. Dosdat, J.; Lanthiez, J.; Levaire, C. (to Compagnie Francaise Thomson Houston-Hotchkiss Brandt). US Patent 3,868,769. 4 Mar 1975. Priority date 8 Jan 1971, France. 4p.

A method of making stabilized superconductors of an intermetallic composition crystallizing according to the A 15 structure

is described including the following steps: forming a stock product comprising a core made of the elements of the superconductive composition and a jacket of good heat and electrical conductivity, wiredrawing the stock product to obtain a wiredrawn product in which the jacket is in close engagement with the multielement core and submitting the wiredrawn product to a heat treatment to transform the multielement core into a superconductor. (Official Gazette)

32955 NEW CURRENT–VOLTAGE CHARACTERISTICS OBSERVED IN SUPERCONDUCTING THIN FILM CROSSINGS. Iguchi, I. (Tokyo Univ.). Phys. Lett., A; 50A: No. 4, 247-248 (16 Dec 1974).

New current-voltage characteristics were observed in superconducting-normal (or superconducting) cross-type junctions. The observed characteristics are simple and general in spite of possible complicated physics involved due to an inhomogeneous current flow. (auth)

32956 PHONON DETECTION BY JOSEPHSON JUNCTIONS. Tredwell, T. J.; Jacobsen, E. H. (Univ. of Rochester, NY). Phys. Lett.; 50A: No. 4, 281-282(16 Dec 1974).

Josephson junctions are found to respond to pulses of coherent phonons at 10 GHz. The coupling of phonons to the junction appears to take place via the deformation potential. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 32815, 34131, 35137, and 35592.

32957 (AGC-2482) FANNO LINE TABLES (ONE-DIMENSIONAL STEADY ADIABATIC FLOW OF A COMPRESSIBLE FLUID IN A CONSTANT-AREA DUCT WITH FRICTION) GAMMA–1.380. (Aerojet-General Corp., Azusa, Calif. (USA)). 8 Feb 1963. 87p. Dep. NTIS $7.50.

Fanno Line tables are presented for one-dimensional steady adiabatic flow of a compressible fluid in a constant-area duct with friction. The calculated values use a γ value, i.e., ratio of specific heats, of 1.380, and flow Mach numbers from 0.120 to 70.000. (LCL)

32958 (AGC-2483) RAYLEIGH LINE TABLES (ONE-DIMENSIONAL STEADY FRICTIONLESS FLOW OF A COMPRESSIBLE FLUID IN A CONSTANT-AREA DUCT WITH HEAT-TRANSFER) GAMMA–1.380. (Aerojet-General Corp., Azusa, Calif. (USA)). 8 Feb 1963. 87p. Dep. NTIS $7.50.

Rayleigh line tables are presented for one-dimensional steady frictionless flow of a compressible fluid in a constant-area duct with heat transfer. The ratio of specific heats, γ, used was 1.380, and the entering flow Mach number in the calculations ranged from 0.120 to 100.000. (LCL)

32959 (COO-2152-15) TWO PHASE PRESSURE DROP ACROSS ABRUPT AREA CHANGES. Husain, A.; Weisman, J. (Cincinnati Univ., Ohio (USA)). Jan 1975. Contract AT-11-1-2152. 123p. Dep. NTIS $9.25.

The research was undertaken to develop a coherent view of two-phase pressure drop across abrupt area changes during steady flow. Specifically the objectives of the program were to: (1) establish an additional data base of observations of two-phase pressure drop across abrupt area changes; and (2) determine whether a single model based one-dimensional momentum theory can correlate the data obtained in the present investigation as well as that in the literature. Examination of the data available in the literature indicated that most of the pressure drop measurements across abrupt area changes were made with the steam-water system. To assure the generality of the correlating approaches developed, it was decided to conduct the test program with a non-water system. The freon-freon vapor system was selected for this purpose. (TFD)

32960 (WANL-TMI-1108) FINITE DIFFERENCING OF COMPRESSIBLE FLOW EQUATIONS BY THE LAX–WENDROFF FOUR POINT METHOD. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 May 1964. 17p. Dep. NTIS $4.00.

A method of finite differencing of the equations for time-dependent compressible flow proposed by Lax and Wendroff is described. Three properties of this method, i.e., the conservation form of the equations, stability of the solution, and truncation error, are discussed. (LCL)

32961 (WANL-TMI-1670) ORIFICE PLATE FLOW NOMOGRAPHS. Chronis, W. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1966. 21p. Dep. NTIS $4.25.

Orifice plates for various mass flow rates have been designed and nomographs made to facilitate rapid readings during testing. The calculation procedure for the orifice plates and a procedure for construction of the nomographs are included. Nomographs for the orifices designed to date for a pressure range of 200 to 750 psia, temperature range from 460 to 560°R and a pressure drop across the orifice from 25 to 100 in. of water are also included. (auth)

32962 ENTRAINMENT MECHANISMS IN ANNULAR FLOW. Hewitt, G. F. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). pp 18-45 of Two-Phase Fluid Thermodynamics. Proceedings of a Symposium Organized by CNEN Under the Sponsorship of the Italian-Latin American Institution. Rome; CNEN (1973).

From Two-phase flow day; Rome, Italy (9 Jun 1972). 51 refs.

The nature of annular flow is reviewed and the various independent and dependent variables are discussed. The mechanism of the liquid entrainment is investigated to assess the relevance of the various studies and to suggest where further work is needed. The methods for measurement of entrained liquid flow are also reviewed and some experimental correlations are presented. (INIS)

32963 THERMAL-HYDRAULIC INSTABILITY. Most Recent Assessments. Bergles, A. E. (Georgia Inst. of Tech., Atlanta (USA)). pp 203-230 of Two-Phase Fluid Thermodynamics. Proceedings of a Symposium organized by CNEN Under the Sponsorship of the Italian-Latin American Institution. Rome; CNEN (1973).

From Two-phase flow day; Rome, Italy (9 Jun 1972). 40 refs.

Thermal-hydraulic instabilities in two-phase flow are examined, considering the identification of the physical mechanism, the documentation of the consequences, the analytical predictions. Instabilities observed in full-scale industrial equipments are described and classified. (INIS)

32964 MODELING METHODS IN TWO PHASE FLOW THERMOHYDRAULICS. Boure, J. A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Transfert et Conversion d'Energie). pp 234-249 of Two-Phase Fluid Thermodynamics. Proceedings of a Symposium Organized by CNEN Under the Sponsorship of the Italian-Latin American Institution. Rome; CNEN (1973).

From Two-phase flow day; Rome, Italy (9 Jun 1972). 23 refs.

The methods used to define scaling factors are recalled, to investigate possible applications to two-phase flows. Examples of scaling laws developed by various methods are given. It is concluded that modeling is in fact of great interest for two-phase flows but that research in this field is still necessary. (INIS)

32965 HEAT TRANSFER AND FLUID FLOW IN COMPLEX GEOMETRIES. Assumptions and Deductions of the Main Subchannel Codes. Bowring, R. W. (UKAEA Reactor Group, Winfrith, Atomic Energy Establishment). pp 121-131 of Two-Phase Fluid Thermodynamics. Proceedings of a Symposium Organized by CNEN Under the Sponsorship of the Italian-Latin American Institution. Rome; CNEN (1973).

From Two-phase flow day; Rome, Italy (9 Jun 1972).

A number of computer codes for thermal and hydraulic analysis of rod cluster assemblies using the subchannel model are examined. The subchannel models adopted are compared discussing the physical assumptions on the subchannel division, film flow, enthalpy of cross-flow and cross-flow pressure differential, dryout calculations. The effects of inaccuracies in the hydraulic correlations and the simplifications of the numerical techniques are also discussed. (INIS)

32966 EXPERIMENTAL COMPARISON OF THERMOHYDRAULIC GODES FOR CLUSTERS. A Research Programme. Flinta, J. E. (Aktiebolaget Atomenergi, Studsvik (Sweden)). pp 139-199 of Two-Phase Fluid Thermodynamics. Proceedings of a Symposium Organized by CNEN Under the Sponsorship of the Italian-Latin American Institution. Rome; CNEN (1973).

From Two-phase flow day; Rome, Italy (9 Jun 1972).

Research programs in progress dealing with the thermohydraulic behavior of coolant in nuclear fuel cluster are presented. Experiments on flow distributions, flow pattern, enthalpy distribution and void fraction in fuel clusters cooled by boiling water or by gas or by sodium are described. The measuring methods are discussed reporting the calibration work need and the instrumentation difficulties. (INIS)

32967 CONVERSION OF THERMAL ENERGY INTO MECHANICAL ENERGY BY GRAVIMETRIC CIRCUITS. Silvestri, M. (Politecnico di Milano (Italy)). pp 251-256 of Two-Phase Fluid Thermodynamics. Proceedings of a Symposium Organized by CNEN Under the Sponsorship of the Italian-Latin American Institution. Rome; CNEN (1973). (In Italian)

From Two-phase flow day; Rome, Italy (9 Jun 1972).

Some studies and experiments on a two-phase fluid circuit to transform directly thermal energy at low temperature (80°) into mechanical energy, by natural convection, are reported. The theoretical and practical difficulties and the possible applications to reactor cooling systems are discussed. (INIS)

32968 EXPERIMENTAL STUDIES ON CHARACTERISTICS OF PRESSURE ATTENUATION AND RECOVERY TO SATURATION FOR DECOMPRESSIVE DISTURBANCES IN LOW PRESSURIZED WATER. Miyazaki, K.; Mukai, K.; Fujii-e, Y.; Suita, T. (Osaka Univ., Suita (Japan). Faculty of Engineering). J. Nucl. Sci. Technol. (Tokyo); 11: No. 7, 284-292(Jul 1974).

Slightly pressurized water ($p_{sat} \approx 1.2 \sim 6.0$ bar) was flashed into steam void by step decompression to atmospheric pressure, using a shock tube type device with vertical test section, made of stainless steel pipe about 2 m long, with an inner diameter of 40 mm. The transient pressure depression below saturation and the time constant of pressure recovery to the saturation were measured, based on the observed transient pressure response signals. The transient pressure curve could be approximated by the expression $p(t) = p_{min} + (p_{sat} - p_{min})(1-e^{-t/\tau})$ for the period immediately following step decompression. This time constant τ represents the effective relaxation time of thermodynamic nonequilibrium. Defining the term decompression ratio ϵ as the ratio of the excess transient depression below saturation pressure to the difference between saturation and atmospheric pressure, i.e., $\epsilon \equiv (p_{sat} - p_{min})/(p_{sat} - p_{in})$, the dependence of ϵ on the vertical position along the test column z and p_{sat} was found to follow approximately the empirical formula $\epsilon = \exp[-\beta'\{(p_{sat}/p_{in}) - 1\}(z + z_0)]$, where β' was evaluated to be 0.43 m^{-1}. Correspondingly, the attenuation constant $\beta \equiv (-1/\epsilon) \cdot d\epsilon/dz = \beta'\{(p_{sat}/p_{in}) - 1\}$. The time constant τ was found to range between 10 ~ 300 msec, with a tendency to increase with decreasing saturation pressure determined by the measured water temperature. The value of τ showed little dependence on the position of observation along the test section. The expression $1/\tau = \beta V$ (V being the propagation velocity of pressure waves) indicates a hyperbolic relation between τ and p_{sat}. This relation roughly agreed with experimental data. (auth)

32969 STUDY ON THE BOILING HEAT TRANSFER FROM A DOWNWARD HEATING SURFACE. Tokita, Y.; Hokai, N. (Mitsubishi Heavy Industries Ltd., Nagasaki (Japan). Nagasaki Technical Inst.). Mitsubishi Juko Giho; 11: No. 5, 631-636 (Sep 1974). (In Japanese).

An experiment on the boiling heat transfer of water from a downward heating surface was conducted to obtain the heat transfer rate and burn-out heat flux. The surface of one end of a copper block with a diameter of 20 mm was used as the heating surface, and the other end of the copper block was heated with an electric heater. Heat flux on the heating surface could be increased up to 1.5×10^6 kcal/m^2h. The test pressure was changed from 0.1 to 3 atm and the sub-cooling temperature was changed from 0° to 70°. The condition of boiling was observed for two cases, (1) for the case in which the heating surface was kept stationary in the cooling water and (2) for the case in which it was given reciprocal motions between the steam and liquid at a cycle of 0.67 to 2 sec and cooled intermittently. Then, the characteristic curve of the boiling heat transfer was obtained from the result of the observation. On the downward heating surface, bubbles formed below the heating surface were apt to coalesce to form a blanket of vapor, which prevented the primary bubbles from separating from the heating surface. As a result, the boiling curve became discontinuous in the nucleate boiling range or shifted to film boiling at a low heat flux, depending on circumstances. Generally, the burn-out heat flux was lower than in the case of upward heating surface, and the intermittent cooling and lower pressures than the atmospheric pressure reduced the burn-out heat flux. (auth)

32970 FORCED CONVECTION HEAT TRANSFER TO A TWO-PHASE MIXTURE OF WATER AND STEAM IN A HELICAL COIL. Crain, B. Jr. Stillwater, OK; Oklahoma State Univ. (1973). 171p. University Microfilms Order No. 75-8745.

Thesis (Ph.D.).

Forced convection heat transfer to high-quality two-phase mixtures of water and steam was studied in two helical coils with diameters of 9.99 and 20.64 inches. The coils were constructed of 0.495 inch ID stainless steel tubing in which heat was generated electrically. Local and circumferential heat transfer coefficients were correlated as a function of the Lockhart-Martinelli parameter. Studies were made of single-phase heat transfer and of system stability. A visual flow study was made with air-water mixtures in a transparent coil. The secondary circulation is quite efficient in distributing liquid to the surface of the tube. Heat transfer coefficients at all circumferential positions remain high up to qualities of approximately 90%. At 90% vapor quality the heat transfer coefficients at the top and bottom circumferential positions decrease sharply and at a quality slightly greater than 90% the heat transfer coefficient at the position on the tube wall farthest from the axis of the helix decreases. The heat transfer coefficient at the position on the tube wall nearest the axis of the helix (90° position) remains substantial at qualities up to essentially 100%. Visual observations confirm the presence of a secondary flow pattern and the presence of a slow-moving liquid stream at 90° position. The study of system stability confirmed that an increase in mass velocity increases the system stability while an increase in heat flux decreases the system stability. The large coil was more stable than the small coil. Heat transfer results were successfully correlated with the Lockhart-Martinelli parameter in the high-quality regime. (Diss. Abstr. Int., B)

32971 TWO-PHASE FLOW STABILITY IN HORIZONTAL CHANNELS. Neshan, H. Stillwater, OK; Oklahoma State Univ. (1973). 185p. University Microfilms Order No. 75-8846.

Thesis (Ph.D.).

Two-phase flow stability was studied in horizontal channels by steady-state measurements of pressure drop and flow rate. The effects of inlet subcooling, inlet orificing, pressure level, heat flux, and geometry on this curve and particularly on the point of the minimum pressure drop were investigated. The test section was constructed from type 304 stainless steel with an outside diameter of $\frac{1}{4}$ inch and an inside diameter of 0.176 inch. Power was supplied by a dc power generator and the test fluid, Freon-113, was evaporated in the test section. The analysis of the experimental results revealed that the point of the minimum pressure drop occurs in the subcooled boiling region. Increasing the inlet subcooling, system pressure, and inlet orificing increased the range of stable operation while increasing the heat flux decreased the range of stable operation. It was found that at the point of the minimum pressure drop the ratio of the actual "heat flow rate" to the heat flow rate required to obtain saturated liquid at the channel exit is a constant value and the value of this constant is dependent only on the length to diameter ratio. The results were nondimensionalized and a stability map was developed which is in good agreement with the results of other investigators. (Diss. Abstr. Int., B)

Materials Testing

Refer also to abstracts 32814, 33923, 34025, 34106, and 35610.

32972 (WANL-TMI-841) TENSILE TESTS OF TIE RODS. Allison, H.; Zibritosky, G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Oct 1963. 4p. Dep. NTIS $4.00.

Tabulated data from tensile tests at 80°F on 30 tie and specimens are presented. (LCL)

32973 (WANL-TMI-860) RESULTS OF TESTS TO EVALUATE HELICAL COIL INSERTS FOR REPAIR OF GRAPHITE THREADS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 11 Nov 1963. 10p. Dep. NTIS $4.00.

In an effort to develop a method of repairing graphite screw threads, 26 helical coils have been inserted in graphite and tested for maximum torque load and pull-out strength. Since there were three distinct tests in this series, the information gathered in the initial test was applied during the second test and, correspondingly the experience gained during the first two tests was utilized in conducting the third. The findings from the first and second series of tests were very inconsistent because of difficulties experienced when installing the inserts. During these tests, the pull-out strengths ranged from a low of 275 lb to a high of 1158 lb, and the applied torque from 30 to 65 in.-lb. Data obtained from the third series of tests, however, show a consistently high pull-out strength. The average pull-out strength for this third series was 1040 lb, and a one standard deviation of 88 lb. For test series one and two, the helical coils were mechanically inserted with tools supplied by the manufacturer, and the manufacturer's instructions were followed precisely. For test series three, the helical coils were manually inserted, and the procedure followed was based on experience. In all cases, the graphite used was extruded-type H4LM, with all holes drilled perpendicular to the grain. Originally, there were six blocks, each of which had one hole per face. Additional holes were drilled as required. (auth)

32974 (WANL-TMI-1754) SUPPORT WASHER CREEP-DEFORMATION INVESTIGATION. Spofford, N. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 13 Feb 1967. 4p. Dep. NTIS $4.00.

The results of compression testing of six ATJ support washers to determine washer creep deformation at room temperature and at 4300°R and 4500°R under various loadings are reported. (LCL)

32975 (WANL-TMI-1755) TUNGSTEN CUPS CARBIDING RUNS. Spofford, N. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Feb 1967. 2p. Dep. NTIS $4.00.

32976 (WANL-TMI-1784) CARBIDE COMPOSITION CUPS, ULTIMATE STRENGTH. Spofford, N. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 May 1967. 1p. Dep. NTIS $4.00.

A carbide composition cup of LASL material, number RHL-147, was tested to ultimate strength at 4300°R. Load was applied to the insulating washer by a graphite plunger and reacted by an A6 design support block. Loading rate was at the standard 0.020 inch per minute rate. Three pyrofoil washers were used, a large and a small (0.550 inch O.D.) between the support washer and cup and a single large diameter between the insulating cup and protection cup. Failure load was 5350 lb with complete shattering of the cup. The ATJ support washer failed in compression and sheared at about a 60° angle circumferentially. The previous failure loading at this temperature was 3800 lb and involved a precracked cup which had gone through an hour's exposure in the single element test rig. In that case, also, the support washer failed in compression. The addition of the pyrofoils is believed to have contributed to the higher strength in that more load is required to make the protection cup's rim contact the support block surface. An indentation of the rim can clearly be seen on the used block where the graphite was not gouged away by the sheared outer section of the support washer. The ledge of the cup broke away cleanly from the side walls and in all probability failed simultaneously with the support washer. Load resistance of the cup and washer combination was close to linear all the way to failure which was quite sudden. With a support washer material which deforms less under loading, higher strengths could undoubtedly be attained, but this appears unnecessary in view of current tie rod strengths. (auth)

32977 (WANL-TMI-1941) PAX LATERAL SUPPORT STRAP. Anderson, R. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Oct 1968. 6p. Dep. NTIS $4.00.

Tensile tests were conducted at ambient conditions on three (3) PAX lateral support straps. The straps were attached to a steel bed plate and tensile loads were applied through a load cell by using an overhead crane. Two dial gages, one at each end, were used to measure the deflection. The straps were pre-loaded to 100 lbs. and the dial gages set at zero. Incremental loads of 25 lbs. were applied until a total load of 300 lbs. was reached. The dial gage at the bed plate end of the strap indicated that there was no movement in the attachment arrangement. A visual examination at the conclusion of testing indicated no visible damage to the straps. (auth)

32978 (Y-1982) DELAYED-FAILURE TEST METHOD FOR URANIUM AND URANIUM ALLOYS IN SELECTED ATMOSPHERES. Hemperly, V. C. (Oak Ridge Y-12 Plant, Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 13p. Dep. NTIS $4.00.

Delayed-failure tests have been made on unalloyed uranium and on two uranium alloys. The delayed failures were obtained with static-load notched specimens in test atmospheres of laboratory air and dry argon, in vacuum, in distilled water, and in dilute nitric acid (pH, 4) at room temperature. (auth)

32979 NEUTRON RADIOGRAPHY WITH MODERATED 14 MeV-NEUTRONS. Jost, P. (Bundesanstalt fuer Materialpruefung, Berlin (F.R. Germany). Fachgruppe Kerntechnik und Strahlenschutz). Materialpruefung; 17: No. 1, 11-13(Jan 1975). (In German).

A description is given of a device for the thermalization of neutrons from the $T(d,n)^4He$ reaction produced by a 150 keV-accelerator. The spatial and the energy dependence of the neutron field as well as the radiographic applications of this device are discussed. (auth)

32980 THE REVIEW ON RADIOGRAPHIC INSPECTION IN 1973. Katsurayama, K. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). Hihakai Kensa; 23: No. 7, 339-341 (Jul 1974). (In Japanese).

The development and trend in the field of radiographic inspection in Japan for the period from January to December 1973 are described in respect to standards, apparatuses and photosensitive materials, methods of inspection, and safety control. New standards of JIS and NDIS are introduced concerning principally welded parts. Automated x-ray radiography for nuclear power components is a feature having emerged in the year. Many reports were made on radiographic techniques. With the spread of radiographic practices, importance of radiation safety is emphasized. (JA)

Nuclear Explosions

Refer also to abstract 32770.

32981 (AD/A-001005) MATERIAL PROPERTIES OF GROUTS AND OF TUFFS FROM SELECTED DRILL HOLES. Final Report, 23 May 1973-31 March 1974. Butters, S. W.; Nielsen, R. R.; Jones, A. H.; Green, S. J. (Terra Tek, Inc., Salt Lake City, Utah (USA)). 10 Jul 1974. Contract DNA001-73-C-0212. 172p. (DNA-3383F). NTIS $6.25.

Rock core samples taken from exploratory drill holes at the Nevada Test Site and cast group samples were tested to determine their mechanical and physical properties. These material properties were used for initial nuclear test site selection and in more detailed site evaluation to insure that proper stemming and containment occurred. The majority of the tests were uniaxial-strain tests; some hydrostatic pressure and triaxial stress compression tests were conducted to furnish necessary moduli and failure criteria. (GRA)

32982 (AD/A-001614) BLAST-INDUCED GROUND MOTIONS: THE SURFACE WAVE AND HORIZONTAL DISPLACEMENTS. Gakenheimer, D. C. (Rand Corp., Santa Monica, Calif. (USA)). Mar 1973. 89p. (R-1113-PR). NTIS $4.75.

Two types of ground motions, resulting from blasts, were investigated, whose fundamental physics are often lost in computer simulations. One is the direct-induced surface wave, and the other is air-blast-induced horizontal displacements. The study used exact formulas for motions in an elastic model of the earth medium. It was found that the particles of the surface wave can move either forward or backward, depending on the initial loading conditions of the blast. Under a superseismic blast, horizontal displacements were found to be either in or out, depending on the Poisson's ratio of the medium and the velocity of the blast wave. (GRA)

32983 (EERL-MP-E-75-4) RESULTS OF AIRBLAST OVERPRESSURE MEASUREMENT PROGRAM AT PROJECT R. D. BAILEY. Hoeft, M. J. (Army Engineer Waterways Experiment Station, Livermore, Calif. (USA). Explosive Excavation Research Lab.). Feb 1975. 52p. Dep. NTIS $4.00.

Methods of predicting gas-vent and ground-shock-induced airblast overpressure levels from underground explosions have been under investigation for many years. In order to obtain an accurate method for predicting peak overpressures and impulses from large-array-type detonations with different delay periods, more data from this type of event must become available. The airblast overpressure measurement program at R. D. BAILEY resulted in a large amount of data to be used, first, in estimating the airblast expected from future detonations in the R. D. BAILEY spillway area and, second, to provide further input to prediction method studies. A discussion of the instrumentation and procedures used to obtain these data is followed by a presentation of the results and an analysis of the results. Since peak overpressures from various detonations were caused by several different airblast-producing mechanisms, no definite conclusions could be drawn concerning prediction methods. It is hoped that the results and their analysis can be used in future prediction method studies. (auth)

32984 (LA-1026(Vol. 24)) WEAPON DATA EFFECTS AND INSTRUMENTS. Volume 24. Section G, Appendices 50-54. Bainbridge, K. T. (ed.). (Los Alamos Scientific Lab., N. Mex. (USA)). 27 Oct 1947. 114p. Dep. NTIS $8.75.

Declassified 8 Apr 1975.

Studies on the Trinity Event are reported. Topics discussed include: radar detection of the cloud; attempt to obtain γ-ray kinephotographs; searchlight plotting of the cloud; cloud-chamber effect in large explosions; and preliminary report on the spectrum and radiation. (TFD)

32985 (LA-5764-MS) PACER PROGRAM. FY 1974 LASL ACTIVITY. References. Shreffler, R. G. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1975. Contract W-7405-eng-36. 608p. Dep. NTIS $33.50.

This report is a compilation of the previously unpublished, unclassified references cited in LA-5754-MS (October 1974), and each is identified by the number assigned to it in that publication. PACER is a power program designed to meet the present energy crisis and the future world energy problem. The idea is to use clean, thermonuclear explosives to heat steam contained in a large underground cavity and to use the steam to operate a conventional electric power plant. (TFD)

32986 (UCID-16708) ASSESSMENT OF MICROFRACTURING IN RIO BLANCO POSTSHOT CORE RB-AR-02. Borg, I. Y. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Feb 1975. Contract W-7405-Eng-48. 16p. Dep. NTIS $4.00.

Microfracturing in the two core sections recovered from the Rio Blanco RB-AR-02 postshot hole is very small. Significant differences could not be detected between the upper core (354 to 378 ft radial distance) and the lower core (181 to 188 ft radial distance). Sections of highly fractured core are all characteristically fine grained silts and clays. The fracturing within them appears to reflect release of stresses when the cores were "sledged" from the barrels. The comparable phenomenon in the coarser sandstones is grain boundary separation. (auth)

32987 (UCID-16722) PERMEABILITY OF A NUCLEAR CHIMNEY AND SURFACE ALLUVIUM, AREA 2, ERDA NTS. Rozsa, R.; Snoeberger, D.; Baker, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Mar 1975. Contract W-7405-Eng-48. 13p. Dep. NTIS $4.00.

Results of field permeability tests made at a fifth nuclear chimney site in Area 2 at the ERDA Nevada Test Site (NTS) are presented. The purposes of this program of field permeability testing are to obtain a permeability data base for test areas at NTS and to develop efficient testing techniques for determining flow characteristics of underground media. Permeability values were obtained by fitting calculated and measured underground pressure response generated by atmospheric pressure changes at the surface. Calculations were made using an analytic solution for Darcy flow in a semi-infinite slab with stepwise, time-varying surface pressure (superposition). The calculated values of pressure diffusivity for the chimney is 0.64 m^2/s and 1.1 m^2/s for the undisturbed surface layer. (auth)

32988 (UCRL-51536) ESSEX-DIAMOND ORE RESEARCH PROGRAM: THE DEVELOPMENT AND MANUFACTURE OF A GELLED NITROMETHANE EXPLOSIVE FOR PROJECT ESSEX. Helm, F.; Boat, R.; Finger, M.; Wooster, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Oct 1974. 46p. (WES-MP-E-74-4; DNA-PR-0004). Dep. NTIS $4.00.

A nitromethane-based explosive was formulated that can be pumped and whose gel structure will uniformly suspend 10 wt % sand for several weeks. Safety and performance characteristics were determined. A 907-kg (1-ton) quantity was manufactured, emplaced 6 m (20 ft) underground, and successfully fired in a cratering experiment at Fort Peck, Montana. An additional quantity of 42 638 kg (47 tons) was manufactured and test-fired in similar experiments with larger charges conducted at Fort Polk, Louisiana. This explosive has stable and predictable detonation characteristics and can be mixed and pumped in large quantities using equipment fabricated from readily available commercial items. (auth)

32989 (UCRL-51740) CONTROLLED BLASTING CALCULATIONS WITH THE TENSOR74 CODE. Heusinkveld, M.; Bryan, J.; Burton, D.; Snell, C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Feb 1975. Contract W-7405-Eng-48. 72p. Dep. NTIS $5.45.

Results of numerical finite-difference calculations designed to simulate the effects of blasting explosives emplaced in medium-strength rock are presented. Calculations were implemented using the TENSOR74 two-dimensional rock mechanics code, which models regimes of material response including explosive energy release (detonation), gas expansion, elastic solid material, and brittle or ductile failure of a solid. The standard configuration consisted of a narrow vertical cylinder of explosive within a sandstone medium, beneath a horizontal free surface. The geometry and explosive depth were selected to simulate typical blasting applications. The standard explosive was nitromethane, which was initiated from the lower end. Variations from this design were made in additional calculations, including top initiation of the explosive, use of ammonium nitrate fuel oil explosive instead of the nitromethane, and reduction of the tensile strength of the sandstone. Frictionless slip surfaces and buffer zones of pre-crushed sandstone were also added to investigate the influence of presplit fracture planes as used commercially and of buffer zones to control the region-of-rock failure around the explosive. Propagation of the outgoing dilatational and shear waves was observed with the aid of the TENPLT graphical output program. The extent of the region of failure and the degree of damage in the sandstone medium were examined. A study was made of the states of pressure and deviatoric stress associated with failure at various locations in the rock. It was found that near the explosive the rock failed in shear at high confining pressure, but farther away the rock failed in tension, with long progressive cracks reaching out radially. The extent of these cracks was found to be highly dependent upon the tensile strength assumed for the rock. (auth)

32990 SEISMIC SOURCE SUMMARY FOR U. S. UNDERGROUND NUCLEAR EXPLOSIONS, 1971–1973. Springer, D. L.; Kinnaman, R. L. (Univ. of California, Livermore). Bull. Seismol. Soc. Amer.; 65: No. 2, 343-349(Apr 1975).

A summary of information is presented for all announced U. S. underground nuclear explosions detonated during the 1971 to 1973 time period. The data include detonation times, locations, and depths of burial, as well as information about shot media and surface collapse (subsidence) phenomena. This summary is an addendum to a previous publication which covered the period 1961 to 1970, and includes some additions and corrections to that work. (auth)

32991 FURTHER STUDIES ON SEISMIC DISCRIMINATION. Evernden, J. F. (U. S. Geological Survey, Menlo Park, CA). Bull. Seismol. Soc. Amer.; 65: No. 2, 359-391(Apr 1975).

Further data on the shape of the $M_S:m_b$ ($6.5 \geq m_b \geq 4.0$) curve for shallow-focus ($D < 50$ km) earthquakes are given along with theoretical explanations of the observed relationships. The frequency and probable cause of "anomalous" earthquakes is discussed. Capability of simple identification criteria (depth ≥ 50 km, detected Rayleigh waves of adequate amplitude, and/or location more then 25 km at sea), based on use of only a fraction of presently available data, is demonstrated. The magnitude of the mixed event (mixed surface waves of earthquakes) problem as it effects identification as well as procedures for circumventing the problem are demonstrated. Finally, recommendations are made for solving some other residual discrimination problems. (auth)

32992 SOME TYPES OF NUCLEAR PROLIFERATION ARE MORE DANGEROUS THAN OTHERS. Lindsey, G. (Dept. of National Defence, Ottawa). Sci. Forum; 8: No. 1, 10-12(Feb 1975).

An increase in the numbers of nuclear weapons possessed by a state already categorized as a nuclear power is generally less dangerous than the acquisition of nuclear weapons by a state for the first time. In the case of terrorists, the acquisition of one nuclear bomb would present a real threat to organized government and could provide a stronger motivation for nonproliferation than do fears for security against aggression by foreign states. (CA)

Protective Structures and Equipment

Refer also to abstracts 32820 and 35136.

32993 (AD/A-001387) DYNAMIC ANALYSIS OF A BUILDING AND BUILDING ELEMENTS. Wiehle, C. K. (Stanford Research Inst., Menlo Park, Calif. (USA)). Apr 1974. 133p. NTIS $5.75.

The objective of the overall research program is to develop an evaluation procedure applicable to existing NSS-type structures and private homes. Past efforts have been concerned with examining exterior walls, window glass, steel frame connections, applications to actual buildings, and reinforced concrete floor systems. This report presents modifications to the mathematical model previously developed for reinforced concrete floor slabs to include the effect of longitudinal restraint on slab resistance. Also included in the report are the development of the resistance function for predicting the collapse of wood-joist floor systems, and the dynamic inelastic analysis of an eight-story steel-frame office building. (GRA)

32994 (CEA-CONF-2957) USE OF SODA-FLUORESCEIN AEROSOL IN THE TESTING OF AIR FILTERS. Dupoux, J.; Pradel, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service Techniques d'Etudes de Protection et de Pollution Atmospherique). 1974. 27p. (In French and English). (CONF-740996-1). Dep. NTIS (US Sales Only) $4.50.

From international symposium on the problems of contamination; London, UK (23 Sep 1974).

The soda-fluorescein aerosol method that is mainly used in France for testing the efficiency of air filters installed at nuclear plants is described. (TFD)

32995 (LA-5883-PR, pp 23-45) INDUSTRIAL HYGIENE. Feb 1975.

In biomedical and environmental research program of the LASL Health Division. Annual report, January–December 1974.

The research activities of the Industrial Hygiene Group include aerosol studies and studies of plutonium and environmental metals in man. The aerosol studies include: computer assessment of air cleaner performance; inhalation hazards from glove box leaks; resuspension of particulates; cyclic flow filtration efficiency; generation of an insoluble aerosol for inhalation studies; and filtration efficiency for particles smaller than 0.1 μm. The plutonium and environmental metals studies include: minimum detection limits and confidence intervals; Pu concentration in urine of early Pu workers; Pu in occupationally exposed workers; Pu in tissues of the general population; isotope screening (diagnostic); trace metal analyses in tissue; studies on Pu workers; and analysis and assessment. (ERB)

32996 (NTO-R-0111) SHIELDING INTEGRITY CHECK (SIC) TESTS FOR THE E-MAD FACILITY. Phase IV. Final Report. Britton, J. M. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 27 Jun 1967. 23p. Dep. NTIS $4.25.

The data and results obtained from the Phase IV portions of the Shielding Integrity Check (SIC) Tests at the E-MAD Building are presented. These portions of the SIC Tests were performed by NERVA Test Operations (NTO). The postmortem intercell walls, Phase IV portion, were tested to disclose any defects in shielding incurred in the construction process. There were four violations of shielding integrity found in this portion of the tests which required construction contractor correction. These violations were repaired and re-checked. Three (3) of the repaired violations were found to pass the shielding integrity standards, and one violation was repaired to the extent that administrative operational control will ensure personnel safety. In addition, sixteen (16) violations were found which require only administrative operational controls. (auth)

32997 INFLUENCE OF GRANULOMETRY AND NATURE OF THE AEROSOL IN THE EFFICIENCY OF HEPA FILTERS. Mazzini, M. (Univ., Pisa). G. Fis. Sanit. Prot. Radiaz.; 18: No. 4, 143-147(1974). (In Italian).

This work is part of a research program on particulate air filters, performed by the Pisa Nuclear Engineering Institute in association with the CNEN (Security and Controls Division) and the CAMEN. Test results showed that granulometry and nature of the aerosol influence the efficiency of HEPA filters. This influence is appreciable, though it does not affect the performance of such filters on plants. (auth)

32998 DESIGN OF RADIOISOTOPE LABORATORY. I. General Planning. Fujii, S. (Shibaura Inst. of Tech., Tokyo (Japan)). Radioisotopes (Tokyo); 23: No. 7, 418-426(Jul 1974). (In Japanese).

General planning and construction of experimental laboratories designed for non-sealed radioisotope work have been described. Particular design in the radioisotope (RI) experiments involves several problems for the prevention against radiation hazards, other than the same essential conditions as ordinary experiments. We have explicated, in order of selection of the location and separation of the irradiation and contamination area considered external exposures, and setting up the control area and determining the maximum permissible dose under the Hazards Prevention Law have been investigated with a view to accommodating the equipment to every variety of the RI experiments. Besides, the construction of the RI experimental equipments and the arrangement of the room inside the facilities have been considered. (N. KANAO)

Safety Engineering

Refer also to abstract 35409.

32999 (WANL-TMI-548) FIRE HAZARDS TEST OF SHIELD CAPSULES. Schreiber, J. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Feb 1963. 5p. Dep. NTIS $4.00.

A fire hazard test was conducted on shield capsules to determine the fire risk involved in working with the LiH-filled capsules. The results showed that sustained combustion is not possible when LiH pellets are confined in their stainless steel capsules and that temperatures of burning LiH are not sufficiently high to melt the capsule walls. (LCL)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstracts 32529 and 33250.

33000 (DAO-4-TM-9) EXPLORATION DRILLING FOR URANIUM IN THE SCHOLLE AREA, TORRANCE COUNTY, NEW MEXICO. Collins, G. E.; Nye, T. S. (USAEC Division of Raw Materials, Albuquerque, N. Mex. Albuquerque Branch Office). Dec 1957. 23p. GJO.

Uranium and copper minerals occur in a conglomerate and sandstone zone in the Permian Abo Formation which outcrops on the east side of Priest Canyon north of Scholle, Torrance County, New Mexico. A drilling program was carried out to evaluate the uranium potential of the area. The results of the drilling indicate that scattered and weak uranium and copper mineralization, associated with carbonaceous plant material, occurs in a broad, meandering paleostream channel. (auth)

33001 (DBO-1-TM-9) URANIFEROUS LIGNITE DEPOSITS OF SOUTHWESTERN NORTH DAKOTA. Haines, G. I. Jr. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). Apr 1958. 21p. GJO.

Uraniferous lignite deposits, similar to those in Harding County, South Dakota, occur in the Fort Union formation of Paleocene age on the west flank of the Williston Basin in southwestern North Dakota. Substantial tonnages of ore-grade material have been developed in thin lignitic beds in the upper part of the Sentinel Butte member. Economically significant deposits are concentrated near Medora, North Dakota, in a north-south mineral belt on the east margin of the Little Missouri River badlands. Uranium in the lignitic beds occurs principally as urano-organic compounds and complexes. Visible uranium and molybdenum minerals are found in the weathered surface zones and the richest portions of the deposits. All lignite beds, uraniferous or otherwise, tend to look alike; but wide physical and chemical variations exist. Some of the uranium deposits are in low rank lignite beds averaging one foot or less in thickness; others are in higher rank lignites, one to three feet thick. All but two deposits are in weathered material. Ore deposition in the North Dakota lignites is attributed to: (1) ground water movement, (2) cross structures intersecting a major structural trough, (3) differential permeability in the enclosing strata, and (4) absorptive qualities of the lignite. The source of the uranium is believed to be weakly-radioactive material in younger tuffaceous beds of the Oligocene White River group. Uraniferous lignite requires special handling and extraction technology; no market presently exists for it. An estimated 500,000 ton reserve in North Dakota is available for processing should costs be made competitive with those in existing areas of uranium production. Additional exploration near known deposits could double the current estimate. (auth)

33002 (DEO-2-TM-3) URANIUM OCCURRENCES IN THE NORTH LARAMIE PEAK DISTRICT, ALBANY AND CONVERSE COUNTIES, WYOMING. Guilinger, R. R. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). Mar 1956. 16p. GJO.

Primary and secondary uranium minerals in addition to copper and lead minerals are found in Precambrian igneous and metamorphic rocks of the North Laramie Peak district in the northern part of the Laramie Range in southeastern Wyoming. The identified uranium minerals include pitchblende, uraninite, coffinite, and uranophane. The principal uranium occurrences are associated with north-northeasterly-trending nearly vertical shear zones that cut schists along the margins of the granite masses. A 2-mile-wide belt of dark colored schists, which crop out from about 5 miles north to 5 miles south of Esterbrook in the eastern part of the district, is considered favorable for potential uranium deposits. Several uranium localities have been discovered in this district, but only one shows a potential for production. Commercially important uranium deposits are improbable in the North Laramie Peak district, although small production is possible. (auth)

33003 (ERDA-tr-18) DESCRIPTION OF THE MAIN BRAZILIAN URANIUM DEPOSITS. Maciel, A. C.; Cruz, P. R. (USERDA, Washington, D. C.). Feb 1975. Translated by I. A. Leonard (W. J. Grimes and Co.), from a Brazilian Paper. 50 p. Dep. NTIS $5.50.

The results of geological reconnaissance in the main uranium ore-bearing sites in Brazil are presented. The results of prospecting and the estimated uranium reserves are given. (ERB)

33004 (GJO-932-1) RELATIONSHIP OF MICROORGANISMS TO URANIUM AND OTHER MINERAL DEPOSITS. Part I. Literature Review and Delineation of a Comprehensive Research Program. Douros, J. D (Denver Research Inst., Colo. (USA)). 11 Sep 1967. 53p. GJO.

The objective of the comprehensive literature search and preliminary investigation which was conducted for the Atomic Energy Commission is to gather information on the role of microorganisms in concentrating, precipitating, and transporting minerals. Although the literature concerning uranium is extremely sparse, considerable information was obtained regarding several other minerals (sulfur, iron, and vanadium). (147 references) (auth)

33005 (RME-32) SUPPLEMENTARY REPORT ANOMALY NO. 50 PUMPKIN BUTTES DISTRICT, WYOMING. Magleby, D. N.; Biggins, J. G. (USAEC Grand Junction Office, Colo.). 30 Oct 1952. 7p. GJO.

In three pits, each 10 to 12 inches deep, the radioactivity and visible uranium minerals continued with depth. Although the high radioactivity (above 500 cps) is confined to a small area of 2,000 square feet, the assay results and the indication of continued mineralization at moderate depths suggest that this deposit may prove to have good possibilities as a small-scale uranium producer. No further work by the Commission is recommended. Careful hand mining or the use of a small power shovel would prove to be the best method for developing this deposit. It is possible that bulldozing or trenching would destroy these apparently small deposits without giving any indications to further uranium mineralization. (auth)

33006 (RME-40) SUPPLEMENTARY REPORT, PUMPKIN BUTTES DISTRICT, ANOMALIES NUMBERED 59-63 AND 64-68, JOHNSON COUNTY, WYOMING. Magleby, D. N. (USAEC Grand Junction Office, Colo.). 1 Nov 1952. 8p. GJO.

The physiography, geology, and mineralogy of the area in which anomalies 59 to 63 and 64 to 68 are located are discussed. It is concluded that most of the deposits are not of ore grade. However, anomalous areas 59 to 63 could be mined economically, as the radioactive float could be removed without any blasting or trenching. The areas 64 to 68 warrant subsurface investigation to determine the depth of the radioactive areas found on the surface. (JGB)

33007 (RME-107) BOYD URANIUM DEPOSIT IN THE FRUITLAND FORMATION, SAN JUAN COUNTY, NEW MEXICO. Chenoweth, W. L. (USAEC Grand Junction Office, Colo. Production Evaluation Div.). Sep 1958. 13p. GJO.

Uranium occurs in a sandstone lens in the lower part of the Upper Cretaceous Fruitland formation at the Boyd claims, 14 miles northwest of Farmington, New Mexico. No uranium minerals are visible, but microscopic uranium minerals from a zone at the base of the sandstone lens were identified. Ground-water leaching has removed much of the original deposit; only that in the lower portion of the host rock remains. (auth)

33008 (RME-126) HORSESHOE AND OTHER DIATREMES OF THE HOPI BUTTES VOLCANIC FIELD, NORTHEAST ARIZONA. Fair, C. L. (USAEC Grand Junction Office, Colo.). Oct 1956. 38p. GJO.

Some diatremes of the Hopi Buttes volcanic field were examined to determine the relation of stratigraphy and structure to the subore-grade uranium present. Bedrock of diatremes examined is either Triassic Wingate sandstone or Pliocene Bidahochi formation. Diatremes exhibit basin-like structure, crop out in a circular or elliptical plan from a few hundred yards to a mile in diameter, and dip toward the center. The sediments are middle Bidahochi and are likely to be altered, slumped, and folded with numerous small faults. The beds are composed of agglomerates or explosion breccia, water-laid pyroclastics, and calcareous lake or spring deposits in different sequences. In addition to these beds, one diatreme contained a thin quartz sandstone and a thick water-lain conglomerate predominantly of basalt gravels and quartz grains. Low-grade uranium occurs in some limestone beds and in poorly sorted, silty, and/or tuffaceous water-laid pyroclastics. In the latter it occurs in channels, wedge-shaped areas formed by intersecting sets of cross-bedding, and porous zones formed by dislocation of beds by eruption of agglomeratic material from an old conduit. (auth)

33009 (RME-141) GUIDEBOOK TO URANIUM DEPOSITS OF WESTERN UNITED STATES. (USAEC Grand Junction Office, Colo.). Oct 1959. vp. GJO.

During the summer of 1959 the U. S. Atomic Energy Commission was host to a group of geologists, mining engineers, and geophysicists from ten foreign countries, interested in methods of exploration for uranium. The Production Evaluation Division of the Grand Junction Operations Office provided a three months training program which included lectures, demonstrations, field and mine mapping, and visits to mines and mills. This guidebook was prepared as an aid to that training program. The guidebook is representative of western United States uranium deposits. The arrangement of the material and the selection of individual mines has been determined by the itinerary of the 1959 tour. Although originally prepared for foreign visitors, this volume will also be valuable in training of A. E. C. personnel. It provides a practical guide to the geology of a wide variety of Unites States uranium deposits. (auth)

33010 (RME-1057) AIRBORNE RADIOMETRIC SURVEY OF AN AREA NEAR SANTA FE, NEW MEXICO. Jedlicka, J. J.; Mallory, N. S. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). 17 Jan 1955. 12p. GJO.

The survey was started February 6, 1954 and terminated May 1, 1954 after 100 hours of flying had been logged. Three anomalies were discovered. The physiography, stratigraphy, and geology of the area are discussed. Only the locality of one anomaly is considered potentially productive. It is in a 3-ft bed of gray calcareous conglomerate in the Chinle formation. Three shallow pits, dug along the conglomerate layer, contained secondary uranium minerals. (MCG)

33011 (RMO-437) GEOLOGY AND ORE RESOURCES OF THE URANIUM-VANADIUM DEPOSITIONAL PROVINCE OF THE COLORADO PLATEAU REGION. Webber, B. N. (Union Mines Development Corp., Grand Junction, Colo. (USA)). [nd]. Contract 7405-eng-78. vp. GJO.

Declassified 21 Mar 1960.

The fundamental purpose of this survey was to reconnoiter the Colorado Plateau region with sufficient study of its general geology, stratigraphy, structure, and the distribution, magnitude and tenor of its ore deposits as was considered necessary to completely evaluate the ultimate potential uranium resources of the region. A total tonnage of localized ore of 5,857,055 short tons, whose average tenor is 0.16% U_3O_8 and 1.42% V_2O_5, has been estimated and divided into three classifications (positive, indicated, and inferred), based on its degree of certainty. Maps were made and submitted. (LK)

33012 (RMO-439) REPORT ON URAVAN DISTRICT, SAN MIGUEL PLATEAU AREA, COLORADO. Smith, C. T. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). May 1946. 106p. GJO.

The Uravan District is the outstanding district in the Colorado Plateau carnotite region in both past production and resources for the future. Reserves of some 1,342,000 tons have been calculated, with average grades of 0.23% U_3O_8 and 1.33% V_2O_5. Of this total some 250,000 tons have been placed in the positive category. A tentative exploration program is outlined. (LK)

33013 (RMO-443) REPORT ON GYPSUM VALLEY DISTRICT, DOLORES PLATEAU AREA, COLORADO. Kirkpatrick, R. K. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). Apr 1946. 58p. GJO.

The potential reserves of the district are approximately 50,000 tons of ore, most of which is over 0.08% U_3O_8 equivalent to grades 1 and 2 ore. The reserve is distributed among several mines and mineralized localities. (LK)

33014 (RMO-448) REPORT ON COMB RIDGE FOLD DISTRICT, SAN JUAN BASIN AREA, UTAH. Chamberlain, V. R. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). Mar 1946. 50p. GJO.

Geologic relations, ore deposits, conditions affecting mining, ore reserves, and exploration of the Comb Ridge Fold District are considered. Results of the study show that in the northern portion of the district a considerable number of small V_2O_5-U_3O_8 occurrences exist. Approximately 11,000 tons of indicated ore have been calculated in this locality. (LK)

33015 (RMO-452) SUPPLEMENTARY REPORT ON GREEN RIVER DISTRICT, SAN RAFAEL SWELL AREA, UTAH. Hill, J. W. (Union Mines Development Corp., Grand Junction, Colo. (USA)). Dec 1945. 18p. GJO.

Vanadium ores in this district occur in the Salt Wash member of the Morrison formation. The ore contains visible carnotite, limonite, much carbonaceous material, and small amounts of replaced wood and bone. Ore deposits and ore reserves are described. Summary Tables of tonnage estimates, maps, and calculation tables of positive and inferred ores are presented. (HLW)

33016 (RMO-457) REPORT OF SLEEPY CAT MOUNTAIN DISTRICT, WHITE RIVER UPLIFT AREA, COLORADO. Gruenerwald, W.; Richardson, G. R. (Union Mines Development Corp., Grand Junction, Colo. (USA)). Sep 1945. 15p. GJO.

Preliminary reconnaissance showed that some U_3O_8-vanadium mineralization occurred in a conglomeratic bed at the base of the Triassic sediments. Accordingly, a more detailed geological investigation was decided upon. A geologic map of the area was prepared, and the prospect was examined and sampled. The conglomeratic bed is considered to correspond to a portion of the Chinle formation of Arizona and Utah. The Stealey prospect was shown to contain only a few tons of low-grade mineralization, and no additional exploration is warranted. The area mapping did not disclose any other loci of mineralization in the district. It was recommended that no further field work be performed in the Sleepy Cat Mountain District. (LK)

33017 (RMO-458) LITTLE ROCKIES DISTRICT, HENRY MOUNTAINS AREA, UTAH. Mastrovich, A. M. (Union Mines Development Corp., Grand Junction, Colo. (USA)). Sep 1945. 35p. GJO.

Declassified 9 Dec 1959.

Geography, geologic relations, ore deposits, conditions affecting mining, ore reserves, and exploration in the Little Rockies District are discussed. The district contains ~8000 tons of relatively rich ore occurring in rather thin beds. (LK)

33018 (RMO-460) REPORT ON RICHARDSON BASIN DISTRICT, GREEN RIVER DESERT AREA, UTAH. Murphy, F. M. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). Jun 1945. 24p. GJO.

The purpose of this investigation was the study of the U_3O_8-vanadium ore occurrences at Richardson Basin, Utah. Ore exposed sufficiently for mining is practically non-existent. On the basis of geological mapping and sampling, some 1,000 tons of inferred reserves, estimated to average 0.08% U_3O_8 and 0.36% V_2O_5, have been calculated. (LK)

33019 (RMO-462) REPORT ON SAN MIGUEL RIVER DISTRICT, SAN MIGUEL PLATEAU AREA, COLORADO. Mastrovich, A. M. (Union Mines Development Corp., Grand Junction, Colo. (USA)). 18 Apr 1945. 17p. GJO.

The Salt Wash member of the Morrison formation throughout the northern portion of the district is thick and contains a high proportion of sandstone. Carbonaceous material, however, is lacking, and this may be responsible for the complete absence, as revealed by the field survey, of vanadium-U_3O_8 mineralization in the Salt Wash of the district. Some small irregular vanadium mineralization, of exceptionally low U_3O_8 content, occurs in the Entrada formation, but these deposits are not capable of any significant production. Mapping of this district nearby districts that are more highly mineralized. (LK)

33020 (RMO-464) REPORT ON WATERPOCKET FOLD DISTRICT, KAIPAROWITS PLATEAU AREA, UTAH. Eakland, E. H. Jr. (Union Mines Development Corp., Grand Junction, Colo. (USA)). 8 Feb 1945. Contract W-7405-eng-78. 21p. GJO.

Vanadium mineralization was absent in the Waterpocket Fold District, but information of regional importance concerning the Salt Wash member of the Morrison formation was obtained. It was recommended that no additional work be done in this area. (LK)

33021 (RMO-466) REPORT ON THE POLAR MESA CAMP (WEST GATEWAY) DISTRICT, GREEN RIVER DESERT AREA, UTAH. Emerson, J. F.; Smith, C. T. (Union Mines Development Corp., Grand Junction, Colo. (USA)). Oct 1944. Contract W-7405-eng-78. 34p. GJO.

The mineralization and its geologic environment were carefully studied for the Polar Mesa Camp District. Results of this study provided information from which 175,770 tons of ore could be inferred. Positive and indicated ore bring the total ore reserve for the district to 262,252 tons. The scheme for further exploration by diamond drilling is given. (LK)

33022 (RMO-469) REPORT ON THE GEOLOGY AND ORE DEPOSITS OF THE B'CLA B'TOH (BECLABITO) DISTRICT, CARRIZO UPLIFT AREA, ARIZONA. Coleman, A. H. (Union Mines Development Corp., Grand Junction, Colo. (USA)). 10 Sep 1944. Contract W-7405-eng-78. 28p. GJO.

The area is described with regard to location, topography, drainage, water supply, timber, accessibility, geology, and ore deposits. The sedimentary beds consist chiefly of sandstone. The formations consist of Carmel, Entrada, lower Morrison, upper Morrison, and Dakota. Several intrusive plugs occur in the area of vanadiferous mineralization. (HLW)

33023 (RMO-471) REPORT ON INTER RIVER DISTRICT, GREEN RIVER DESERT AREA, UTAH. Smith, C. T. (Union Mines Development Corp., Grand Junction, Colo. (USA)). Jun 1944. 40p. GJO.

The Morrison formation with the well-defined Salt Wash sandstone member at its base occurs in three distinct and well-exposed cartographic lobes. The proposed exploration involves only the eastern lobe. Practically all of the recent Metals Reserve production came from recent discoveries; hence this district does not present a mined-out appearance. It is felt that the suggested exploration of 10,000 to 15,000 ft. of drilling will add a material reserve. Drilling is indicated in approximate figures. Economic considerations, mineralization, and vanadium ore deposits are discussed. (HLW)

33024 (RMO-473) REPORT ON THE CISCO DISTRICT, GREEN RIVER DESERT AREA, GRAND COUNTY, UTAH. Emerson, J. F. (Union Mines Development Corp., Grand Junction, Colo. (USA)). Mar 1944. Contract W-7405-eng-78. 6p. GJO.

A geological survey of the Cisco District was conducted to map and examine the Salt Wash Member of the Morrison formation for possible carnotite mineralization. No trace of vanadium-SOM mineralization was found in the area. The Summerville, Morrison, and Dakota formations are described with regard to shale and sandstone content. (HLW)

33025 (RMO-474) REPORT ON HELIUM DOME DISTRICT, SAN RAFAEL SWELL AREA. Kirkpatrick, R. K. (Union Mines Development Corp., Grand Junction, Colo. (USA)). 11 Feb 1944. Contract W-7405-eng-78. 6p. GJO.

The Helium Dome District is a twelve-mile strip of the outcrop of the Salt Wash member of the Morrison formation on the east flank of the San Rafael Swell, Utah. The topography is described. The stratigraphy consists of Jurassic, Entrada, Curtis, Summerville, Morrison, Cretaceous, Dakota, and Mancos formations. Areal distribution and structure are described. No carnotite-type vanadium mineralization was found in the district. (HLW)

33026 (RMO-881) CARNOTITE DEPOSITS NEAR EDGEMONT, SOUTH DAKOTA. Baker, K. E.; Smith, L. E.; Rapaport, I. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). Feb 1952. 13p. GJO.

Numerous outcrops of carnotite were examined. The mineral occurs as interstitial fillings between sand grains, as joint fillings, and as thin coatings, mostly in thin-bedded sandstone layers in the Lakota formation of Lower Cretaceous age. In Craven Canyon the carnotite seems to be confined to three principal horizons within the lower 150 feet of the Lakota, in proximity to a thin bed of carbonaceous shale. In Coal Canyon, however, probably the higher portions of the Lakota formation are mineralized. In general, the Edgemont deposits resemble the uranium ore occurrences of the Colorado Plateau. But, as no development work has yet been done in this new district, the size, shape, and average grade of the potential ore bodies can only be inferred. The distribution and size of well mineralized outcrops in an area of considerable size affords reason to believe that the Edgemont district will become an important source of uranium ore. The Lakota formation, in which the Edgemont deposits occur, extends over a much larger area of South Dakota and Wyoming than has yet been prospected for uranium. (LK)

33027 (RMO-890) RECONNAISSANCE OF SOME RED BED COPPER DEPOSITS IN THE SOUTHWESTERN UNITED STATES. Gibson, R. (Harvard Univ., Cambridge, Mass. (USA)). Feb 1952. Contract AT(49-1)-705. 78p. GJO.

A reconnaissance of many of the copper deposits in the Red Beds of New Mexico, Arizona, Oklahoma, and Texas carried out in the summer of 1951 yielded chiefly negative results from the standpoint of uranium production. With the possible exception of the Grand View mine, which will require further investigation, none of the deposits seen in this survey gives promise of being of commercial interest for uranium at the present time. (auth)

33028 (RMO-3006) DESIGNS AND DESCRIPTIONS OF MECHANICAL SUBSAMPLE CUTTERS USED IN REDUCING URANIUM CONCENTRATE SAMPLE SIZES. Johnston, R. L. (Pitkin (Lucius), Inc., Grand Junction, Colo. (USA). Western Uranium Project). 1 Dec 1965. Contract AT(05-1)-912. 41p. GJO.

A portable, mechanical, straight-line secondary sampler and a smaller mechanical arc-path type tertiary sampler have been designed and fabricated for use in reducing a uranium concentrate primary sample. The secondary sampler can be set with a timer device to cut representative subsamples of any desired weight within a range of 500 to 2000 grams. It can cut representative subsamples in this range from quantities of minus ¼ inch particle size concentrate varying in weight from 50 pounds to 1200 pounds. The tertiary sampler is used to subsample an unblended, unpulverized secondary sample. It is capable of cutting representative tertiary samples as small as 14 grams or as large as 125 grams. Descriptions, detailed sketches, and photographs of these two mechanical subsamplers, with the results obtained in evaluating their capabilities, are presented. (auth)

33029 (S-386-R) ARMS NEW HAMPSHIRE AREA SPECIAL AERORADIOACTIVITY SURVEY. Reskovac, R. R.; Trundle, A. S. III. (EG and G, Inc., Santa Barbara, Calif. (USA)). Jun 1967. 46p. GJO.

EG & G measured the radioactivity in the White Mountains area of New Hampshire, using the Aerial Radiation Measurements System (ARMS). Particular attention was given to the areas containing formations of Conway granite. Gross-count and spectral measurements were made, and these data are presented in relation to the known geology of the area. Various other methods of data collection were employed and are briefly evaluated in this report. (auth)

33030 (SLAO-TM-4) AIRBORNE RADIOMETRIC SURVEY, KERN AND SAN LUIS OBISPO COUNTIES, CALIFORNIA. Bowes, W. A.; Mallory, N. S. (USAEC Salt Lake Area Office, Salt Lake City, Utah (USA)). Oct 1956. 17p. GJO.

A low-level airborne radiometric survey covering granitic, metamorphic, volcanic, and sedimentary rocks in fault terrain of the Sierra Nevada and Coast Range provinces was conducted in Kern and San Luis Obispo counties, California, during the spring of 1955. Six radioactive anomalies were located. Limited prospecting is recommended for only one of the anomalies. This project was designed to supplement ground study in the evaluation of uranium as related to the regional structural pattern in Kern and San Luis Obispo counties, California. Rugged terrain, coupled with the thin, poorly exposed nature of the known vein deposits in the region may have curtailed effectiveness of the airborne radiometric survey. (auth)

33031 (SLAO-TM-5) AIRBORNE RADIOMETRIC SURVEY OF FOUR AREAS IN SOUTHWESTERN MONTANA, 1956. Pruitt, R. G. Jr.; Magleby, D. N. (USAEC Salt Lake Area Office, Salt Lake City, Utah (USA)). Aug 1958. 13p. GJO.

A low-level airborne radiometric survey was made of four areas in southwestern Montana from June 18 to August 7, 1956. Areas I and II, the southern Elkhorn Mountains, and an area between the towns of Bozeman and Livingston, Montana, respectively, were thoroughly investigated. Areas III and IV, the Gravelly Range and the upper Gallatin Valley, respectively, were only briefly examined. These areas were chosen for surveying because they exhibit geologic similarities with the Pryor Mountains area of south-central Montana where commercial deposits of the uranium mineral tyuyamunite were discovered. Radioactive occurrences are not known to exist in the areas investigated, and no radioactive anomalies were detected during the course of the investigation. (auth)

33032 (SLAO-TM-7) AIRBORNE RADIOMETRIC SURVEY OF ELKO COUNTY, NEVADA. Peterson, A. M. (USAEC Salt Lake Area Office, Salt Lake City, Utah (USA)). Dec 1958. 12p. GJO.

Four months and ten days of airborne operation were required to radiometrically survey Elko County, Nevada. A total of 124 hours and 45 minutes of rim and grid flying was conducted during which four anomalies and one area of extremely high radioactive background were detected. One of the anomalies is on the Western Shoshone Indian Reservation, the others on public land. Two of these anomalies were posted for the public July 16, 1956. A Piper Super Cub (PA-18) equipped with a Mark VI Scintillometer was used for the first three months of the survey, and a Piper (PA-18 "A") equipped with a Mt. Sopris Airborne Scintillometer was used for the remaining period of the survey. The radiometric survey of Elko County, Nevada, was conducted by the Atomic Energy Commission from May 10, 1956 to September 21, 1956. Throughout the project operations were based at Elko, Nevada. The area was recommended for surveying due to: (1) the occurrence of primary uranium mineralization, (2) the favorable outlook for uranium minerals to be associated with the many intrusive contacts, and (3) its inaccessibility to ground travel. (auth)

33033 (SLAO-TM-8) AIRBORNE RADIOMETRIC SURVEY OF CENTRAL OREGON. Barlow, J. L.; Magleby, D. N. (USAEC Salt Lake Area Office, Salt Lake City, Utah (USA)). Nov 1956. 8p. GJO.

An airborne radiometric survey of four areas of central Oregon was conducted during August and September 1956. Complete coverage was made in the vicinity of cinnabar mines, intrusive rocks, prominent faults, and localities of high-background radioactivity. No previously unknown uranium occurrences were found. The areas included in this investigation were selected for survey-

ing on the basis of one known uranium occurrence and because of the metallogenetic relationship of uranium and cinnabar (mercury sulfide) in south-central Oregon. The only anomalous radioactivity detected was at the uranium occurrence in Area 3, which had been discovered prior to this investigation. (auth)

33034 (STI/PUB-374) FORMATION OF URANIUM ORE DEPOSITS. Proceedings Series. Proceedings of a Symposium Held in Athens, Greece, May 6–10, 1974. (International Atomic Energy Agency, Vienna (Austria)). Nov 1974. 560p. (In Several Languages). (CONF-740587-). IAEA $38.00.

Separate abstracts were prepared for the 43 papers included. (CH)

For abstracts of individual papers see: 33047–33089.

33035 (TM-1-D-16) POLAROID CAMERA AS AN AID IN MAPPING OPEN-PIT MINES. Marks, L. Y. (USAEC Division of Raw Materials, Denver, Colo. Denver Exploration Branch). Dec 1957. 10p. GJO.

By careful use of the Polaroid camera and ordinary surveying equipment, maps of mine faces can be made with less time in the field than by direct wall sketching, and the accuracy of the resulting maps is comparable. Advantages of the camera method are: (1) Less field time is needed. This is important where plans to back-fill soon after mining or other factors limit available field time. (2) A permanent photographic record of the mine faces can be retained. The camera method is best adapted to open-pit mines, as space and illumination requirements are better met there. (auth)

33036 (TM-74) EXPLORATION DRILLING, DRY VALLEY DISTRICT, SAN JUAN COUNTY, UTAH. Teichman, R. A. Jr.; Fisk, I. T.; Thompson, C. D. (USAEC Grand Junction Office, Colo.). 6 Jun 1955. Contract AT(05-1)-225. 7p. GJO.

Exploratory drilling to evaluate the potential and ore reserves in the Dry Valley district was conducted in the President Wilson, Waterfall, and Frisco groups of claims between August 25, 1953, and February 11, 1954. A total of 40,664 feet were drilled under Contracts AT(05-1)-225 and AT(05-1)-236 into the upper sandstone of the Salt Wash member of the Jurassic Morrison formation. Of the 183 holes drilled, 21 were ore holes, 41 mineralized holes, and 121 were barren. The average grade of the ore is 0.34 percent U_3O_8, 1.83 percent V_2O_5, and it has an average thickness of 2.2 feet. Orebodies in these areas are small and tabular and of the carnotite-vanadium type. (auth)

33037 (TM-76) INVESTIGATION OF THE CALYX NO. 3 MINE, TEMPLE MOUNTAIN AREA, SAN RAFAEL SWELL, EMERY COUNTY, UTAH. Baumgardner, L.; Noble, E. A. (USAEC Grand Junction Office, Colo.). 10 Apr 1957. 12p. GJO.

Calyx No. 3 mine is typical of the calyx-hole mines in the Temple Mountain area of the San Rafael Swell. The uranium ore is produced from a cross-bedded sandstone in the lower part of the fluviatile Moss Back member of the Triassic Chinle formation. Uranium and vanadium are contained in asphaltic hydrocarbons which impregnate the ore sandstone. Paleochannel control of the ore in the Calyx No. 3 mine is not obvious, but a comparable control is present in the form of a permeable sandstone unit overlain and underlain by units of lower permeability. (auth)

33038 (TM-83) RECONNAISSANCE FOR URANIUM IN PART OF THE ROAN AND BOOK CLIFFS AREA OF EAST CENTRAL UTAH. Young, N. B.; Young, R. G. (USAEC Grand Junction Office, Colo.). 29 May 1956. 11p. GJO.

During the period September 20 to November 10, 1955, a reconnaissance search for uranium deposits was made in some Upper Cretaceous and Lower Tertiary strata of the Bean and Book Cliffs in Grand, Emery, and Carbon Counties, Utah, extending from Sunnyside eastward beyond Cottonwood Creek. The area studied is roughly 75 miles long and 5 miles wide. Objectives of this reconnaissance were examination of prospects in a region where there has been little prospecting; determination of the uranium potential of the Tuscher, North Horn, and Colten formations of Upper Cretaceous, Paleocene, and Eocene age, respectively; and stimulation of private activity. (auth)

33039 (TM-85) PETROGRAPHY OF THE BLACK TODILTO LIMESTONE AREA WITH RESPECT TO PROCESSING PROPERTIES. Laverty, R. A. (USAEC Grand Junction Office, Colo.). 27 Aug 1954. 34p. GJO.

Two types of black ore are found in the Todilto limestone in the Grants District, New Mexico, fluoritic and non-fluoritic uraninite. The carbonate leach process with $KMnO_4$ oxidant that is now in use at the Bluewater Mill of the Anaconda Copper Company is probably making satisfactory recovery on the non-fluoritic ores, but since the two ore types are usually mixed, the overall recovery leaves much to be desired. The low recovery on the fluoritic ore is due to the intergrowth of fluorite and uraninite on a submicroscopic scale, possibly on a colloidal scale. Textures found in the fluoritic ores are pictured. (auth)

33040 (TM-117) EXPLORATORY DRILLING IN THE NASH CAR LOCALITY, WHITE CANYON AREA, SAN JUAN COUNTY, UTAH. Oertell, E. W.; Spencer, D. F. (USAEC Grand Junction Office, Colo.). 21 Mar 1957. 14p. GJO.

The Nash Car locality is in the White Canyon area approximately 60 miles west of Blanding, San Juan County, Utah. Exposed sedimentary rocks ranging in age from Permian through Jurassic (?) have a total thickness of more than 1,800 feet in this locality which is on the west flank of the Monument upwarp. An explorative drilling program in 1953 consisted of 16 diamond drill holes totaling 5,199 feet. Ore grade of sub-ore grade uranium deposits were penetrated by 5 of the drill holes; three of these mineralized holes are ore grade. Uraninite and sulfides replace carbonaceous material in fluviatile sedimentary rocks of the Shinarump member of the Triassic Chinle formation. These sedimentary rocks fill a channel cut into the underlying Moenkopi formation. Guides for uranium ore deposits are channels, discontinuous scours along the floor of the channel, and concentrations of carbonaceous material and copper minerals. (auth)

33041 (TM-122) FRACTURES OF CIRCLE CLIFFS AREA, Garfield County, Utah. Hemminger, M. C. (USAEC Grand Junction Office, Colo.). 9 May 1957. 7p. GJO.

The major joint trends in the Circle Cliffs area are believed to predate the anticlinal uplift, and those joints on the steeper flank which parallel the strike of the beds and dip westward normal to the bedding planes owe their present attitude to tilting of strata during uplift. Relaxation of compressive forces and their vertical resultants allowed the formation of tensional, high-angle normal faults and grabens striking approximately at right angles to the original direction of nearly horizontal compression. It is believed that vertical and northeast-southwest compressional forces acting from deep seated overthrusts formed the Circle Cliffs anticline. (auth)

33042 (TM-123) FRACTURING IN THE SAN RAFAEL SWELL, EMERY COUNTY, UTAH. White, R. L. (USAEC Grand Junction Office, Colo.). 15 May 1957. 16p. GJO.

A ground check of faults and joints in the San Rafael Swell was made, supplemented by use of photogeologic maps, aerial observations in some areas, and study of lineations on aerial photographs. Fault and joint trends, direction of fault displacements, and in some instances the amount of displacement, were mapped. Normal gravity faults, grabens and horsts are predominant, and appear to be divisible into five areal sectors of distinctive characteristics. Some fault traces can be followed up through the stratigraphic section through the Carmel formation and into the Entrada sandstone. Major faults displacing the Cretaceous formations south of Green River, Utah, do not appear to be related to any major fault system in the San Rafael Swell, though a few cut into the beds on the flank of the Swell. There is at present only limited evidence of local horizontal thrust faulting. Most joints are normal to the bedding, but in the steeply-dipping east flank there are also a few nearly vertical joints, oblique to the tilted bedding. The major joint trends along the east flank do not appear to be related to the general form of the Swell. Ore bodies in the Swell are both offset by faults and found along faults. Ore bodies at Temple Mountain are elongate along major fracture trends. (auth)

33043 (TM-127) RECONNAISSANCE OF THE CRETACEOUS AND TERTIARY URANIUM DEPOSITS IN THE WASATCH PLATEAU, UTAH. Kastelic, W. R.; Scott, K. E. (USAEC Grand Junction Office, Colo.). 16 Aug 1967. 10p. GJO.

In the summer of 1956, geologic reconnaissance was made of the anomalous radioactive outcrops in the Cretaceous-Tertiary North Horn formation, the Tertiary Flagstaff limestone, and the Tertiary Green River formation of the Wasatch Plateau, Sanpete and Emery Counties, Utah. Deposits in the North Horn formation in the vicinity of Ferron Canyon are confined to upper lacustrine beds of early Paleocene age. Calcium phosphate nodules, fossil bones, and sandstone boulders found as float are hosts to uranium mineralization. Outcrops in the Flagstaff limestone near Flagstaff peak are only slightly radioactive. However, lithologically favorable beds in the Flagstaff may contain commercial amounts of uranium. Near Axtell, Utah, an outcrop of anomalously radioactive conglomerate is found at the base of the Green River formation. Bulldozer stripping has exposed this conglomerate for 150 feet and further prospecting in this area may extend this favorable zone. (auth)

33044 (TM-184) URANIUM OCCURRENCES ON THE GOODNER LEASE SANDOVAL COUNTY, NEW MEXICO. Kittle-

man, L. R. Jr.; Chenoweth, W. L. (USAEC Grand Junction Office, Colo.). 15 Jul 1957. 14p. GJO.

The Goodner Lease, located on the Ojo del Espiritu Santo Grant, Sandoval County, New Mexico, contains the only known occurrences of visible uranium minerals in the Morrison Formation of the Nacimiento Mountains. Weak mineralization occurs at sandstone-claystone contacts and in thin zones within sandstone beds in the Brushy Basin and Westwater Canyon Members. An unusual color change in the sandstones occurs in the area and is believed to be related to the uranium mineralization. (auth)

33045 (TM-188) MAPPING OPEN-PIT MINES WITH A STANDARD FILM CAMERA. Marks, L. Y. (USAEC Grand Junction Office, Colo.). Apr 1960. 16p. GJO.

The purpose of mine mapping is to present geological and other features accurately on a scale drawing of the mine wall. This can be done, by utilizing the described photographed method, in less time than is required for mapping a mine wall with equal accuracy using a nonphotographic method. This enlarged-corrected-photo method is especially useful in large mines where features are inaccessible to the man performing the mapping. The enlarged-corrected-photo shows all features in their correct position (except for minor errors due to wall irregularities, including benches) without estimation, and only three surveyed points are needed in each negative used. The standard film camera, or enlarged-corrected-photo, method is considered superior to the Polaroid camera, or fixed-scale-contact-photo, method and reasons are given. (MCG)

33046 (TM-189) URANIUM OCCURRENCES OF THE NACIMIENTO REGION, SANDOVAL, AND RIO ARRIBA COUNTIES, NEW MEXICO. Chenoweth, W. L. (USAEC Grand Junction Office, Colo.). Jun 1972. 15p. GJO.

Uranium in the Nacimiento region is known to occur in rocks of Pennsylvanian, Permian, Triassic, Jurassic, and Cretaceous age. Deposits consist of uranium minerals disseminated in sandstone, carbonaceous shale, coal and limestone and in association with carbonized plant debris in red bed copper deposits. Known deposits are small and sub-economic. Slightly more than 600 tons of low grade ore has been produced to date. (auth)

33047 WORLD URANIUM SUPPLY CHALLENGE: AN APPRAISAL. Nininger, R. D. (Atomic Energy Commission, Washington, DC). pp 3-18 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The world demand for uranium during the remainder of the century is projected at around 4 million tons. It could be greater if the trend toward the use of electricity is accelerated and if other fuels continue to become more expensive. The increase in uranium production which will be required is unprecedented in the history of mineral development and poses a major challenge to uranium geology and exploration. World reserves at a cost of up to \$15/lb U_3O_8 are estimated at little more than 2 million tons and additional resources at an equivalent amount. However, the production levels needed toward the end of the century will require a resource base approaching three times the present resource estimates. Uranium deposits in sandstone and quartz-pebble conglomerates presently represent the preponderance of uranium resources. Yet there is a question whether geological limitations on the occurrence of such deposits may preclude their discovery in numbers sufficient to meet the eventual resource needs. New types of deposits, low in grade but larger in size, representing the equivalent of the porphyry copper deposits, may supply the bulk of future resource additions. Further investigation is needed on the characteristics of such deposits and the means of their identification. Similarly, additional investigation is needed to determine whether limits on the more conventional deposits do in fact exist and, if not, what advanced approaches to rapid identification of additional such deposits might be employed. The world probably cannot rely on the very low-grade deposits such as most uraniferous black shales for both economic and environmental reasons. There is probably a minimum grade between 100 and 500 ppM below which uranium deposits cannot be effectively exploited for nuclear power. (auth)

33048 GEOCHEMICAL DISTRIBUTION OF URANIUM AS A PRIMARY CRITERION FOR THE FORMATION OF ORE DEPOSITS. Brinck, J. W. (International Resources Consultants B. V., Alkmaar, Netherlands). pp 21-32 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Outstanding questions concerning the formation of uranium ore deposits can be divided into several broad categories. Apart from the economic aspect of ore deposits, which hardly enters at all in studies of this kind, the largely qualitative questions of how and where generally have attracted more attention in economic geology than the at least equally important question of how much. The use of a log-binomial model of element distribution in the geological environment was particularly useful in answering this last question and thus has contributed substantially to a better evaluation of the long-term supply problem for uranium. The same approach is presently used for several other mineral resources by Société des Consultants Indépendants et Neutres de la Communauté Européenne S.C.I.E.N.C.E. sprl., Brussels, under contract with the Commission of the European Communities. Some implications of this model for making an inventory of regional mineral potential and the selection of favorable exploration areas by multi-element geochemical surveys are discussed. (auth)

33049 GEOCHEMICAL FACTORS CONTROLLING THE FORMATION OF THE SECONDARY MINERALS OF URANIUM. Dall'aglio, M.; Gragnani, R.; Locardi, E. (CNEN, Rome). pp 33-48 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The formation of secondary uranium minerals directly from natural waters is examined. There is evidence of some geochemical processes that are capable of creating conditions favorable for the precipitation of secondary minerals, even when there are no primary uranium(IV) occurrences. Direct experience indicates that at least two hydrogeochemical processes are responsible for the precipitation of secondary uranium minerals; namely the leaching of crystalline rocks, even with a normal content, under particular erosion and weathering conditions in the wet temperate climatic zone. This process occurs, for instance, on the Sila Plateau in the Calabria region (Italy), where autunite is still precipitating; and evaporitic processes of inland waters under arid climatic conditions, an example of which is furnished by carnotite deposits in the calcrete area of Western Australia. The results obtained in the course of hydrogeochemical studies carried out in the Sila Plateau and in Western Australia are presented. The secondary mineral precipitation as a step toward the forming of uranium ore bodies in a multistage minerogenetic process is discussed. (auth)

33050 BEHAVIOR OF URANIUM DURING CRYSTALLIZATION OF MAGMAS: WITH SPECIAL EMPHASIS ON ALKALINE MAGMAS. Bohse, H. (Univ. of Copenhagen); Rose-Hansen, J.; Sorensen, H.; Steenfelt, A.; Lovborg, L.; Kunzendorf, H. pp 49-60 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

In a number of series of igneous rocks the uranium content decreases toward the younger members, which is generally explained as a result of a release of uranium during crystallization of the magmas. This trend of evolution is described from the Ilímaussaq intrusion, South Greenland and is considered a result of retention of uranium in the magma owing to the formation of complex ions. It is thus possible to build up concentrations of uranium in residual melts even in rock series displaying low contents of uranium. (auth)

33051 GEOCHEMICAL AND MINERALOGICAL STUDIES OF EUXINITE AND ITS ALTERATION PRODUCTS IN GRAPHIC PEGMATITES FROM HARRAR, ETHIOPIA. Augustithis, S. S.; Mposkos, E.; Vgenopoulos, A. (Univ. of Athens). pp 61-71 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Metamictic euxinite occurs in a graphic pegmatite from Harrar, Ethiopia. Owing to differential leaching by chemical weathering of the euxinite, an alteration margin was produced, which is relatively depleted in Nb and U in comparison with the unaltered euxinite. In this alteration margin there is relatively more Y and Ti. Mineralogically the alteration margin includes relics of euxinite, anatase, and perhaps ampangabeite. Additional studies showed that by heating the metamictic euxinite to 580°C, some lattice restoration occurred; however, complete euxinite lattice restoration occurred at 770°C. (auth)

33052 SOLUBILIZATION AND INSOLUBILIZATION OF URANIUM FROM GRANITES BY HETEROTROPHIC BACTERIA. Magne, R. (CEA-ENSG, Nancy); Berthelin, J. R.; Dommergues, Y. pp 73-88 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy (Nov 1974). (In French)

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Batch cultures and semi-continuous flow perfusions are used as experimental devices to study microbial solubilization and insolubilization of uranium from granites by heterotrophic bacteria. The nutrient media are synthetic (with dextrose or amino acids) or natural (with mine water containing organic compounds). Microbial activity increases 2 to 97 times the solubilization of uranium. The processes are biosyntheses of complexing or chelating compounds. The microorganisms involved are soil microflora and bacteria of mine water and granites. Some species are identified. Microbial insolubilizations of uranium are described in batch cultures. These processes involve biodegradation of uranium binding organo-compounds. These biodegradations occur after long periods of incubation and promote some neoformations of uranium deposits. Black and yellow deposits are observed and described. These experimental results suggest the model described in the paper. This model seems to apply easily to superficial processes of solubilization and concentration of uranium and in reworking deposits. However, in the case of primary intragranitic uranium deposits it is only an hypothesis correlated by the existence of favorable environmental conditions for bacterial growth and by some geological observations mentioned in the paper. (auth)

33053 INFLUENCE OF MICROFLORA ON THE GENESIS OF URANIUM OCCURRENCES AT UDAISAGAR, UDAIPUR DISTRICT, RAJASTHAN. Jayaram, K. M. V.; Dwivedy, K. K.; Bhurat, M. C.; Kulshrestha, S. G. (Dept. of Atomic Energy, New Delhi). pp 89-98 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

An area of 6 km^2 in the vicinity of Udaisagar shaft was investigated to study the role of sulfur and iron-oxidizing bacteria in the mobilization of uranium in the carbonaceous phyllites and its redeposition in breccias and the fault gouge. The Aravalli metasediments consisting of conglomerates, phyllites, impure limestones, carbonaceous phyllites, and ferruginous-breccia are intruded by granites and gneisses. The general strike is: N20°-30°W-S20°-30°E with an easterly dip of 60-85°. Uranium mineralization is confined to a fault gouge in a 6 × 200 m zone, at a depth of 25 to 45 m from the surface. The ore contains stringers of uraninite associated with uranyl minerals and some iron and copper sulfides. It analyzes 0.7% FeO, 2.31% Fe_2O_3, 6.3% C, 2.97% SO_4^{2-}, 0.85% moisture and 0.03-0.06% U_3O_8 and has a bacterial population of 2.3×10^6/g of dry solids. It has a pH of 2.2 to 4.5 and a redox potential of -360 to -480 mV. The ore samples show disequilibrium in favor of uranium. Samples of the ore analyzing 0.03% and 0.06% U_3O_8 yielded a leachability of 43.3% and 67.8% respectively at 60% P.D. (solids) in 6-h leaching time, using water alone. The carbonaceous phyllites in the immediate vicinity analyze 3.04% FeO, 2.96% Fe_2O_3, 11.2% C, 0.11% SO_4^{2-}, 0.15% moisture and 0.0005 to 0.0027% U_3O_8 with a pH of 7.0-8.5 and a redox potential of -200 to -280 mV. The occurrence of significantly higher radon values in the vicinity of the shaft (35.5 pCi/cm^3), the shallow nature of the deposit, absence of any major channel for waterborne transportation as indicated by resistivity surveys, the presence of elemental sulfur, soluble sulfates, and microflora in the ore samples and the high leachability of uranium in water alone show that uranium is mobilized from the carbonaceous phyllites and redeposited in the fault gouge. (auth)

33054 ROLE OF ORGANIC MATTER IN THE ACCUMULATION OF URANIUM. Breger, I. A. (Geological Survey, Washington, DC). pp 99-124 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Geochemical studies were carried out on 64 specimens of coalified logs from Triassic and Jurassic uranium-bearing sediments of the Colorado Plateau and from Paleocene and Eocene sediments of Wyoming. These logs contain from 0.0005 to 16.5% uranium. Autoradiographic studies and observations of relative reflectivities of uraniferous and non-uraniferous specimens demonstrate that uranium was introduced into the coal epigenetically in solution along micro-faults and/or shrinkage cracks. Following its introduction, probably as a complex alkali uranyl carbonate, the uranium was reduced by the coal to form uraninite or coffinite. Data indicate that radiation from the uranium and its equilibrium daughter products causes radiochemical dehydrogenation and demethanation of the coal. This transformation results in significantly higher reflectivity and hardness related to cross-linking that produces diamond-like clusters of carbon atoms. Irradiation of the coal does not cause its rank to rise to that of anthracite. Organic sulfur contents up to 13.1% were noted for coalified logs of Triassic age from the San Rafael Swell area. Such unusual values were attributed to the interaction between the coal and hydrogen sulfide from underlying sediments at temperatures of 110 to 120°C corresponding to burial under about 3000 m of overburden. If uranium was introduced into the sediments following the interaction between the coal and the hydrogen sulfide, this mineralization could not have occurred before Late Cretaceous time. This work, in context with previous studies, has led to a generalization of principles underlying the association of uranium with coal. (auth)

33055 ROLE OF HUMIC NATURAL ORGANIC MATTER IN URANIUM CONCENTRATION. Calvo, M. M. (Junta de Energia Nuclear, Madrid). pp 125-137 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974). (In Spanish)

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

A short experiment on the metallogenetic aspect of the uranium-organic matter association in nature is reported. Several experiments were carried out on uranium fixation by organic matter with different degrees of maturity. Although further studies are considered necessary, the results already obtained lead to the following conclusion: when uraniferous solutions come into contact with humic organic matter, the efficiency and nature of the uranium-organic matter association thus established depends on the degree of carbonization attained by the humic material. At the beginning of the development process, the organic matter has high chemical activity and the uranium tends to occur in stable organic phases. As the process continues, a stage is reached from which uranium tends to form its own minerals independently of organic matter. From the coalification stage onward the tendency toward uranium-organic matter association becomes increasingly less in any form. Petrographically, the humic constituents to which uranium is closely and positively related belong to the huminite maceral group. Lastly, it is considered that when the organic matter is present as an accessory constituent in other sedimentary rocks and with quite low maturity indices, there is greater favorability for the formation of uranium deposits. (auth)

33056 CONCEPTS OF URANIUM-ORE FORMATION IN REDUCING ENVIRONMENTS IN SANDSTONES AND OTHER SEDIMENTS. Adler, H. H. (Atomic Energy Commission, Washington, DC). pp 141-168 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Reliance will be placed on sandstones as a source of uranium for many years to come inasmuch as they contain nearly a third of the world's resources and in excess of 95% of the US reserves. The mobility of uranium depends on the solubility of the uranyl ion in ground water, and precipitation of the metal as ore is governed almost exclusively in sandstones by chemical reduction. The fate of uranium in sandstones is dependent primarily on the existence of a variety of conditions and circumstances under which reductants form and accumulate. The redox recycling process, which involves considerable mobility of uranium, is prominently involved in the formation of uranium ores in the Wyoming basins and in the Grants area, New Mexico, but is more restricted in areas where vanadium abundantly accompanies uranium and fixes the uranyl ion as insoluble vanadate. The major deposits in sandstone are classifiable into peneconcordant and roll types on the basis of morphological relationships; however, a further breakdown of deposits on the basis of the geochemical environment of deposition is more useful in determining where new occurrences might be found. From a genetic standpoint roll-ore deposits may be divided into four principal types. These are the Wyoming-type, which is associated with a prominent redox interface created by oxidation of indigenous reductants by oxygenated ground waters; the Plateau-type roll, which reportedly is encircled by pyritic sandstone and has therefore been interpreted as a primary depositional feature; the Entrada- or Rifle-type, which the writer attributes to diffusion of H_2S and ore-forming cations toward a stationary interaction zone separating a trapped oil or gas pool from wedges of fresh water which press against and confine the location of the hydrocarbon-H_2S-bearing medium and its reaction interface; and the Texas-type, which is formed by H_2S introduced along faults into the host sands from underlying gas and oil deposits. Redistribution deposits formed by reworking of preexisting tabular deposits in the Grants, New Mexico area are genetically classified with the Wyoming-type rolls. Ore deposits in eolian sandstones, such as the ores at Rifle, Placerville, and Grants, are identified with a bleached zone overlying the normally red facies of the host rock. At Grants and Placerville, and in the intervening San Juan Basin, the bleaching appears to be related to H_2S development in the Todilto Sea immediately following the end of Entrada deposition. The once-pyritic, now limonitic, bleached zone of the Entrada contains several small occurrences of ore in outcrop, and speculation is raised as to the possibilities for ore formation at depth where known deposits of oil and brack-

ish water suggest that reducing conditions still remain. Tabular (peneconcordant) deposits are also classifiable according to the nature and source of the reductant controlling ore deposition. Deposits associated with introduced humate substances make up a substantial part of US resources. The suggested genetic connection between these deposits and overlying paleo-bogs and swamps raises some concern regarding the replication elsewhere of resources of similar kind and magnitude. Sandstones and other classic sediments may play a role in uranium-ore formation by serving as paleoaquifers which conduct uraniferous ground waters or other solutions toward loci in adjoining less-permeable sediments containing suitable reductants, e.g., bituminous limestones and shales. The Todilto-Entrada relationship is one example, and several deposits (some non-uraniferous) in the Permian of Europe and the Precambrian of the USA may reflect a similar association. (auth)

33057 DISTRIBUTION OF ELEMENTS IN SOME ROLL-TYPE URANIUM DEPOSITS. Harshman, E. N. (Geological Survey, Denver). pp 169-183 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Roll-type uranium deposits are crescentic in cross-section and elongate along the margins of large tongues of altered sandstone. The alteration was produced by the ore-bearing solutions. Host rocks are arkosic or siliceous sandstone interbedded with siltstone. They are late Mesozoic to late Tertiary in age, and of continental or marginal marine origin. Analyses of close-spaced samples, taken in suites across ore bodies in Karnes and Live Oak Counties, Texas; the Gas Hills and Shirley Basin areas of Wyoming; and the Black Hills area of South Dakota, show that elements were added to and removed from the host sandstone in bands or zones that show a remarkably consistent pattern. Similar genetic processes therefore appear to account for all deposits studied. Twelve elements are discussed, five of them in detail for their particular genetic significance. Uranium, selenium, vanadium, molybdenum, and ferrous iron-bearing minerals have been deposited outwards from the edge of the altered tongue in exactly the same sequence as required by their redox potentials. Furthermore, these elements are ones that can or must be transported in neutral to somewhat alkaline solutions. Elements such as copper, that are mobile only in acid solutions, are not present in the ore in significant amounts. Roll-type uranium deposits seem best explained by transport of elements in neutral-to-alkaline oxidizing solutions, and by deposition of component minerals by a drop in Eh that reached a minimum with deposition of jordisite at a considerable distance from the edge of the oxidized tongue. (auth)

33058 ZONING IN THE ALTERED TONGUE ASSOCIATED WITH ROLL-TYPE URANIUM DEPOSITS. Granger, H. C.; Warren, C. G. (Geological Survey, Denver). pp 185-200 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The altered tongues associated with roll-type uranium deposits commonly include a border zone that separates the hematitic core of the tongue from enclosing reduced pyritic rocks. This border zone, herein called the alteration envelope, can have characteristics that range from limonitic orange to bleached in appearance. It is postulated that a metastable mineral assemblage developed in this zone during genesis of the roll deposits. A tentative model of roll formation is proposed, in which oxygenated ground waters percolating through the hematitic core zone react abruptly with authigenic siderite and elemental sulphur in the alteration envelope. This results in the creation of soluble ferric thiosulphate complex ions, $Fe(S_2O_3)^+$, which can flow past the siderite and sulfur without significant change. When the ferric thiosulfate ions contact pyrite, however, they react to release ferrous iron, elemental sulfur, and thiosulfate. Some of the ferrous iron precipitates as siderite and the remainder is transported ahead in solution with the thiosulfate to be reprecipitated as iron sulfides. Upon termination of roll formation, the zone containing siderite and elemental sulfur can be leached or can alter slowly to limonite or pyrite. The various characteristics of the alteration envelopes are therefore believed to be attributable to mild post-ore processes. (auth)

33059 GENESIS AND CHARACTERISTICS OF THE SOUTHERN POWDER RIVER BASIN URANIUM DEPOSITS, WYOMING, USA. Dahl, A. R. (Exxon Co., Denver); Hagmaier, J. L. pp 201-218 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Uranium deposits in the southern Powder River Basin of Wyoming are excellent examples of large roll-type ore bodies. The host rocks are Paleocene sandstones deposited as point bars by a meandering stream. The source of uranium is tuffaceous and arkosic debris indigenous to the sedimentary sequence containing the host rocks. The largest deposits of highest grade occur near the distal margins of permeable, slightly dipping sandstones where they grade laterally into organic-rich siltstones, claystones and lignites deposited in backswamp or flood basin environments. The deposits are epigenetic in origin, formed by precipitation of uranium from groundwater solutions that moved through the host rocks from a recharge area southwest of the deposits toward a discharge area northeast of the deposits. The deposits are large because the host rocks are extensive and the groundwater system remained relatively stable. Pyrite formed early in and around the host units through a biogenic process utilizing sulfate-reducing bacteria. This was important in establishing a permissive geochemical environment for later ore genesis. Oxidation of pyrite by incursing groundwater caused sulfite to form. Sulfite disproportionation into SO_4^{2-} and HS^- developed the final reducing mechanism for uranium precipitation in the ore rolls. Deposit characteristics and associated alteration products are compatible with the chemical theory of Granger and Warren. (auth)

33060 ALTERATION OF DETRITAL MAGNETITE-ILMENITE IN CONTINENTAL SANDSTONES OF THE MORRISON FORMATION, NEW MEXICO. Adams, S. S.; Curtis, H. S.; Hafen, P. L. (Anaconda Co., Grants, NM). pp 219-253 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Minor amounts of magnetite and ilmenite are now present locally in the fluvial sandstones of the Morrison Formation. Where these minerals are absent or strongly altered, particularly within and adjacent to uranium deposits, the sands contain authigenic leucoxene, anatase, and perhaps other titanium oxide minerals. Studies of thin sections and heavy mineral concentrates from drill-hole cuttings and core have identified stages in the alteration of ilmenite and magnetite. These alterations are interpreted to have occurred in oxygen-deficient ground waters through the selective dissolution of iron from the magnetite and ilmenite. This dissolution may have been promoted by dissolved organic species. The sites of altered titaniferous magnetite and ilmenite are now occupied by clots of titanium oxides. The intensity of a series of periods of alteration, resulting from variations in the oxidation potential within the ground waters, can be recognized in some instances. It is suggested that the chemical conditions which produced the alteration assemblages described here are essentially those under which the uranium deposits formed. Most important, the interpretation of these alteration assemblages in thin sections and drill cuttings is a useful exploration guide for those deposits in which there is an antipathy between detrital ilmenite and magnetite and uranium mineralization. (auth)

33061 SANDSTONE-TYPE URANIUM DEPOSITS IN THE PROTEROZOIC STRATA OF NORTHWESTERN CANADA. Morton, R. D. (Univ. of Alberta, Edmonton). pp 255-273 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Epigenetic uranium deposits within a Proterozoic, marine to continental, volcanic-sedimentary sequence are described from the Great Slave Lake region of NW Canada. Mineralization occurs in faulted and folded, fluviatile arenites and rudites, in part metamorphosed to a maximum of the zeolite facies of regional metamorphism. The sediments carry interstitial, disseminated uranium minerals, which clearly replace pre-existing sulfides and are associated with hematite or graphite. Genetic hypotheses are forwarded and it is suggested that these deposits, being possibly generated by metamorphic fluids, might be of a type intermediate between those associated with younger sandstones at shallow levels and syn-metamorphic vein deposits. (auth)

33062 REVIEW OF URANIUM OCCURRENCES IN PERMIAN SEDIMENTS IN EUROPE, WITH SPECIAL REFERENCE TO URANIUM MINERALIZATIONS IN PERMIAN SANDSTONE. Barthel, F. H. (Bundesanstalt fuer Bodenforschung, Hanover). pp 277-289 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

This summary from the literature reviews the uranium occurrences in Permian sediments in Europe. It covers primarily the most important, mineable uranium occurrences in sandstone in France, Italy, Yugoslavia, and Hungary. Uranium in sandstone

most commonly occurs in fluviatile, lacustrine, and deltaic deposits and is related to the presence of plant remains, carbonized wood, and pyrite as reducing agents. Concentration processes are strongly influenced by the presence of clayey horizons. A feature of the lithology and facies which was observed is a relation between uranium concentrations and a change of color of the sandstone from grey to red. In connection with the genesis of the sandstone mineralization, the occurrences in mixed sedimentary and volcanic deposits are treated in detail. The mineralization related to volcanism and Permian volcanic rocks may have had an influence on the later enrichment processes in the sediments. Examples are used to illustrate the processes in the course of the metamorphosis of uranium enrichments of sedimentary origin. Finally, the genetic conditions accompanying the enrichment of uranium in bituminous shales and in coal are reviewed. (auth)

33063 PERMO-TRIASSIC URANIUM ORE IN THE AUSTRIAN ALPS: PALEOGEOGRAPHIC CONTROL AS A GUIDE FOR PROSPECTING. Petrascheck, W. E. (Montanistische Hochschule Leoben, Austria); Erkan, E.; Neuwirth, K. pp 291-298 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Since 1968, a large-scale prospecting campaign for uranium ore has been carried out in Austria. Research in the Western and Southern Alps was concentrated on the sandstone facies of the Permian and Lower Triassic. These beds, partly developed as red and grey sandstones, partly as semi-metamorphic quarzites and sericite-chlorite schists, are terrestrial and lagoonal in origin, while their upper parts are of shallow marine origin. After rearrangement of these deposits, which appear in their original position in the different overthrusted nappe systems, distinct troughs and platforms can be delineated according to the variations of the thickness of the beds. These features interfere with the general E-W strike of the Alpine geosyncline, following predominantly a transversal direction, which was conditioned by the prealpine Hercynian structures. The comparatively larger uranium layers are situated in or nearest the areas of greater thickness, that is, in the Permian troughs. A remobilization and reconcentration of uranium happened in those localities where younger hydrothermal solutions have penetrated into uraniferous sandstones. (auth)

33064 GENETIC CHARACTERISTICS OF URANIUM DEPOSITS ASSOCIATED WITH PERMIAN SANDSTONES IN THE ITALIAN ALPS. Mittempergher, M. (CNEN, Rome). pp 299-312 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The Permian continental sandstones of the Alps show numerous small uraniferous, stratiform epigenetic occurrences. The most interesting occurrences are related to a basal member mainly composed of grey sandstones and conglomerates, which represent sediments formed in a piedmont environment. These sediments are not oxidized and differ from the overlying red sandstones (typical of an environment strongly oxidized) of alluvial and coastal plain sedimentation. The control of the mineralization was seen to be linked to the permeability and the reducing environment caused by the presence of organic matter in the piedmont sediments. The continental sedimentary basin that began to form in the Lower-Middle Permian evolved during the Triassic-Permian into a marine basin, lasting through the whole Mesozoic. This evolution of the basin did not cause processes of remobilization of the pre-existing mineralizations, while the effects of the diagenesis and of the Alpine metamorphism hardly modified the structure of the deposits. (auth)

33065 URANIUM ORE DEPOSITS IN THE PERMIAN SEDIMENTS OF NORTHWEST YUGOSLAVIA. Lukacs, E.; Florjancic, A. P. (Geoloski Zavod, Ljubljana, Yugoslavia). pp 313-329 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Experts of the Belgrade Institute for Geological and Mining Research and Nuclear Materials Analysis, applying aeroradiometric prospecting techniques in the area under consideration, have discovered over 60 radioactive anomalies in the Middle Permian Groeden formation. They have delimited five areas as productive uranium deposits. These areas, with the exception of the central part of the Zirovski Vrh, are still insufficiently explored. On the Zirovski Vrh one finds sandstone, siltstone, slate and conglomerate mainly of a red color but, especially in the lower part, there are productive green and grey horizons. Stratigraphically, the mineralization depends only on the greenish-grey formation. The spatial distribution of mineralization by uranium shows that the largest concentrations of uranium are in formations characterized by a wide variety of reduction and precipitation conditions. It has also been established that the most important mineral of the deposit is pitchblende. The morphological characteristics provide the basis for a classification by types of the ore bodies which are indicative of the genesis of the deposit. The authors assume that this deposit is of complex formation and they classify it as syndiagenetic. (auth)

33066 MINERAL-GEOCHEMICAL CHARACTERISTICS AND GENESIS OF THE ZIROVSKI VRH URANIUM DEPOSIT. Markov, C.; Ristic, M. (Institut Pour les Investigation, Belgrade). pp 331-341 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974). (In French)

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The Zirovski Vrh uranium deposit is situated in the Gorenja Vas region, to the west of Ljubljana, Slovenia, a region of Permian and Triassic sediments. The uranium ore occurs in grey gredenian sandstone or in slightly metamorphized conglomerates and breccias. These rocks are composed of: quartz, fragments of quartz porphyry and metamorphic rocks; then, mica, feldspar and silicosericitic cement; lastly, carbonates, organic matter, resistant heavy minerals, sulfides and uranium ore. The mineralized bodies are in the form of bands or lenticles distributed within the sedimentary stratum, which is about 20 m thick. The uranium ore is pitchblende. The concentration of uranium in the ore is 0.01 to 5%, amounting to over 10% in a very few places. In the sandstone and conglomerates of the grey uraniferous series there are a number of elements (Cu, Zn, Pb, As, Y, etc.) of which the greater part was precipitated epigenetically in that series, where their distribution is very dependent on the distribution of the carbonates, the organic matter, the sulfides and the pitchblende. The uranium and other metals were precipitated from underground waters and deposited at the limit of the oxidation and reduction media, which represented the geochemical barrier. Gradual metamorphism of the sandstones led to the transformation of the argillaceous cement into chlorite and sericite and of the organic matter into anthracite, with the fractionation and deposition of uranium. (auth)

33067 LITHOLOGICAL FEATURES AND FACIES OF URANIUM ORE DEPOSITS IN FORMATIONS IN THE SOCIALIST REPUBLIC OF ROMANIA. Kornichuk, I. (Ministry of Mining, Oil, Industry, and Geology, Bucharest); Burtik, T. pp 343-357 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974). (In Rumanian)

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Some of the uranium ore occurrences associated with multicolored rocks of Permian-carboniferous age in Romania show concentrations great enough to encourage exploitation. Although they have certain features in common (lithological and structural controls, mineralogical composition, and so on) some geological characteristics of the formations in which the mineralization (which does not always crop out) is localized tend to hamper exploration and prospecting. Generally speaking, the uranium ore deposits occur in a series of multicolored rocks representing a transitional stage between series of grey and red rock. In this transition the ore is associated with grey and grey-green rocks consisting of conglomerates, gritstones and sandstones. The rocks most favorable for uranium accumulation exhibit great permeability and sharp lithological contrast, and were formed in alluvial and lacustrine-alluvial facies. Important in the ore deposition process was the presence of lithological, tectonic and structural screening that promoted its accumulation. The ore bodies are stratified and lenticular in shape, lie concordant with the strata for the most part, and exhibit sharply defined lithological control. The uranium mineral is pitchblende, finely dispersed segregations of which are observed inside bitumen. Less frequently one encounters pitchblende and uranium black unassociated with bitumen, but always lying close to it. Several theories have been put forward with regard to the genesis of these occurrences (such as syngenetic, exogeno-epigenetic, or hydrothermal origin), but clearly the genesis of these ore deposits was highly complex and both exogenic and endogenic factors must have contributed to their formation. (auth)

33068 FACTORS GOVERING THE DISTRIBUTION OF ELEMENTS IN THE URANIFEROUS SHALES OF THE LODEVE PERMIAN BASIN (HERAULT, FRANCE). Herbosch, A. (Univ., Brussels). pp 359-380 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974). (In French).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Detailed petrographic, chemical, and mineralogical studies were performed with about a hundred samples taken from the

carrier beds of a stratiform regional anomaly (uranium and to a lesser extent molybdenum, lead, and astatine). These beds, consisting of finely laminated dolomitic and bituminous pelite, point to lacustrine episodes which occurred cyclically in the Lower Permian within a thick continental pelite-sandstone fill of the red beds type. Besides the heavy-metal anomaly, these rocks are distinguished by their extremely small grain size, the presence of finely dispersed organic matter and an abundance (30-60%) of minerals of recent origin: ankerite, low-temperature albite, chlorite and sulphides. Factorial analysis in the R mode with 21 chemical variables enables one to describe 78% of the initial variance in terms of eight correlated factors which take into account all the intercorrelations. Identification of these factors with the fundamental geological processes involved in the formation of these rocks (diagenesis of the sulphides in a reducing medium, agitation of water, aggradation of dioctahedral clays, detrital clays, alkalization, production of organic matter, diagenetic migration of sulphides) makes it possible to reconstruct with a high degree of accuracy the medium in which sedimentation occurred and the paleogeographic environment. From the stratigraphic point of view, the mathematical model enables one to characterize objectively and quantitatively this excellent example of areas of retarded sedimentation, which is in this case a metallotect for uranium. (auth)

33069 URANIUM IN SIWALIK SANDSTONES, SULAIMAN RANGE, PAKISTAN. Moghal, M. Y. (Atomic Energy Minerals Centre, Lahore). pp 383-403 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Uraniferous lenses are known to occur in seven localities over a strike length of more than 100 miles along the foothills of the Sulaiman Range in Pakistan. The best exposures are at Baghal Chur where extensive drilling has been done. The uranium mineral at Baghal Chur and other localities is metatyuyamunite in the oxidized zone, while in the unoxidized zone it appears to be uraninite or coffinite. The mineralized lenses are up to 300 ft in length and width and 7 to 9 ft thick. No ore controls have yet been recognized. The denudation of the rising Himalayas is considered to have been the original source of the uranium found in this area. Its mode of transport and deposition in the Sulaiman Range is still under investigation. (auth)

33070 URANIUM MINERALIZATION IN SIWALIK SANDSTONES FROM PAKISTAN. Basham, I. R. (Inst. of Geological Sciences, London); Rice, C. M. pp 405-418 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The mineralogy of a sandstone uranium deposit in the fluviatile Siwalik sandstones of the Sulaiman Range in Pakistan has been studied by a variety of techniques including fission track radiography and electron probe analysis. Uraninite and coffinite characterize the non-oxidized zone whereas the principal uranium-bearing mineral in the oxidized zone is tyuyamunite. Uranium concentrations are also found associated with goethite, hematite, martite, biotite and plant debris. Uraninite and coffinite are considered to be authigenic together with häggite, anatase, an expanding clay mineral, heulandite and calcite and ground-water behavior is therefore an important control on mineralization. Mineralization is commonly associated with plagioclase undergoing solution and with quartz mica schist fragments (carbonaceous varieties possibly being preferred). The source area for the Siwaliks lay to the north and comprised predominantly low-grade schists and slates. A possible source of the uranium is detrital uranium minerals derived from the rising Himalayas. (auth)

33071 URANIUM DEPOSITS IN THE KAROO SUPERGROUP NEAR BEAUFORT WEST, CAPE PROVINCE, SOUTH AFRICA. von Backstroem, J. W. (Atomic Energy Board, Pretoria). pp 419-424 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

During the past two years sporadic occurrences of uranium mineralization of variable grades have been discovered in the Beaufort Group of the Karoo Supergroup of sedimentary rocks in the area around Beaufort West, Cape Province. Up to now, uranium mineralization has been confined to the Lower Formation of the Beaufort Group. Although the tenor of surface mineralization varies from trace amounts to more than 2%, average grades are below ±0.05%. The principal surface manifestation of uranium mineralization in the Karoo rocks is the bright green and yellow coloration displayed by the secondary uranium minerals, mainly along joint planes. No attempt has been made to evaluate the resources of the newly discovered uranium deposits in the Karoo Supergroup, since the exploration and investigations to date are still regarded as inadequate and it is too early to predict their significance and true potential. An understanding of the origin of the Karoo deposits is paramount if their exploration is to be pursued intelligently. (auth)

33072 CONTROLS AND GENESIS OF URANIUM MINERALIZATION IN SOME GEOLOGICAL ENVIRONMENTS IN INDIA. Udas, G. R.; Mahadevan, T. M. (Dept. of Atomic Energy, New Delhi). pp 425-436 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The favorability factors influencing localization of uranium are discussed in relation to some selected geological environments in India, namely, the Tertiary Siwalik sedimentary basin along the Himalayan foothills, the Permian Motur and Bijori beds on the Satpura Gondwana basin in Central India, the Palaeozoic phosphorites of the Mussoorie Krol-Tal basin, certain Precambrian conglomerates and sandstones in the Dongargarh system of Central Madhya Pradesh, and some syenitic and granitic rocks from different parts of India. The association of uranium with the copper-lead-zinc mineralization in the Bihar-Madhya Pradesh-Rajasthan metallogenic province and the tectonic controls in localization of uranium are briefly discussed. Instances of fluorite-uranium association in India are cited which support the use of fluorite as a favorable clue in the search for uranium. (auth)

33073 GENESIS OF URANIUM DEPOSITS OF THE TONO MINE, JAPAN. Katayama, N.; Kubo, K.; Hirono, S. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). pp 437-452 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The uranium deposits of the Tono mine, Gifu Prefecture, Japan, occur in the basal part of the Toki group of Miocene age, and are distributed in the tributaries or at the head of channels on the plane of unconformity under the formation. These features characterize the basal ground-water type of uranium deposit, and they are unique in that their typical ore mineral is a zeolite of the heulandite-clinoptilolite group, uranium being adsorbed in it. The history of formation of the Tsukiyoshi deposits, the most intensely explored in the Tono mine, is presented. The matrices of conglomerates and sandstones of the Toki group usually contain tuffaceous material, which has been montmorillonitized or zeolitized diagenetically. The conduit of uranium-bearing ground waters that migrated from the basement granites into the Tertiary sediments was controlled by the impermeable barriers, which are rocks in which montmorillonite predominated, or by the Tsukiyoshi fault, as well as by channel structures. Where the waters became rather stagnant, uranium was adsorbed in zeolite from them. Enrichment of uranium further proceeded locally as follows: pyrite was oxidized to produce sulphuric acid solution which leached the uranium that had been adsorbed in zeolite. The pH of the uranium-rich solution became higher and higher in the course of migration and, as soon as it reached about 4, the uranium in the solution was again adsorbed in zeolite, the uranium content of which may have been enriched up to 0.9%. Coffinites have been formed where uranium was accumulated over the adsorption capacity of zeolite or where strongly reducing conditions were maintained by carbonaceous matter. (auth)

33074 FAKILI (TURKEY) URANIUM DEPOSIT AND ITS FORMATION. Kaplan, H.; Uz, S.; Cetintuerk, I. (Minieres de Turquie, Ankara). pp 453-465 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974). (In Turkish).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The Fakili deposit is situated in the Aegean region, in the west of Turkey. The rocks in the vicinity of the deposit consist principally of the metamorphic series of the Menderes Massif and Neogene sediments. The metamorphic series, comprising mainly augen-gneisses, constitutes the basement rock of the Neogene sedimentary basin. The Neogene sediments can be divided into three categories: the detrital series lowest down, above that the marl series and then lacustrine limestone. The detrital series consists of clays, silts, sands, gravels and conglomerates. The lower parts are distinctly fluviatile, with intersecting stratification. Higher up within the series, starting at the lower fluviatile sediments, are the lacustrine sediments, with horizontal beds providing for lateral continuity. The marl series consists of alternating clay and tuffite layers with silts, sandstone and marls;

it is inhomogeneous and irregular, with many changes of facies. At the same stratigraphic level, however, there are two distinct facies: the first is generally representative of the series and contains marls; the second is the Fakili facies, distinguished from the first by a number of characteristics—variegated colouring, absence of marl, presence of secondary gypsum and sedimentary pyrites, and a generally higher level of radioactivity. The Fakili uranium deposit is located in this facies. The lacustrine limestones are the youngest sediments of the Neogene lake. The Fakili uranium deposit was created in two phases: syngenetic precipitation and epigenetic concentration. At the start of the sedimentation of the marl series, the lake water was rich in dissolved uranium. The Neogene detrital series became enriched in sulphate compounds near the base of the Fakili facies; the sulphate concentration is at a maximum above the contact with the Fakili facies and decreases as one moves upwards. This high sulphate concentration is the result of evaporation in this part of the lake. Evaporation, which concentrated the sulphate compounds to the point where they precipitated, also concentrated the dissolve uranium, which was abundant in this level of the lake. The waters of the lake were first acidic, but then became neutral—owing partly to the decline in the sulphate concentration. The uranium, which cannot remain in solution in neutral water, began to precipitate intensively following the anhydrite; this was the first phase—syngenetic precipitation of the uranium in the lake. At the end of the Neogene, the lake receded and the Neogene sediments began to undergo alteration and erosion through atmospheric influences. During the filtration of vadose waters, the uranium, which had passed into solution for the second time, precipitated as sulphate compounds in the heterogeneous zones above the contact at the base of the Fakili facies. This process of epigenetic concentration explains the present characteristics of the lenses in the Fakili uranium deposit. (auth)

33075 ORIGIN OF URANIUM IN OLIGOCENE QATRANI SEDIMENTS, WESTERN DESERT, ARAB REPUBLIC OF EGYPT. El Shazly, E. M.; El Hazek, N. M. T.; Abdel Monem, A. A.; Khawasik, S. M.; Zayed, Z. M.; Mostafa, M. E. M.; Morsi, M. A. (Atomic Energy Establishment, Cairo). pp 467-478 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Uranium mineralization has been discovered in the Oligocene sediments in the northern part of the Western Desert of Egypt by the Egyptian Atomic Energy Establishment. The mineralization occurs in various forms as uraniferous phosphatic sandstone, uraniferous ferruginated sandstone, uraniferous carbonaceous clay, uraniferous clay, uraniferous limestone, uraniferous tubes, and uraniferous fossil wood. The mineralization has been investigated in the field and in the laboratory by various techniques which helped to elucidate its conditions of deposition, characteristics, and genesis. A theory is advanced to account for the origin of Qatrani sediments whereby the uranium has been mainly carried by thermal brines of acidic oxidized nature initiated by Oligocene subvolcanic activity indicated by the presence of relics of geysers. The tectonic elements operating at that time are comparable to those acting on the Oligocene stage of development of the Red Sea, and transcurrent faulting has been in operation. The environment of deposition is dominantly fluviatile to fluviomarine where the sediments have been transported to the site of sedimentation by a river system draining higher areas located to the SE or ESE. Qatrani area and its vicinity were at that time the site of a delta under subtropical climatic conditions with abundant fauna and flora. Uranium has been laterally distributed in the media of this environment according to the favored stratigraphic horizons, lithology, and structure. (auth)

33076 SIMILARITIES AND DIFFERENCES IN FAVORABILITY CRITERIA FOR VARIOUS SEDIMENTARY FORMATIONS IN THE IBERIAN CORDILLERA. Martin-Delgado Tamayo, J.; Fernandez Polo, J. A. (Junta de Energia Nuclear, Madrid). pp 479-491 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974). (In Spanish).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The paper describes the geological features of the Iberian cordillera and its adjacent zones where prospecting and exploration of uranium deposits in sedimentary formations are now in progress. The authors specify the most significant data and the standards which can serve as a guide in evaluating the nature and degree of favorability. A description is given of the best-known types of deposits and their similarities to, and differences from, other localized anomalies. Thus, the authors define the Picofrentes type in the Lower Cretaceous of Soria, the Mazarete type in the Lower Triassic, the Miocene paleochannels of Palencia and the lignite-containing basins. (auth)

33077 BASAL PROTEROZOIC UNITS AS FOSSIL TIME MARKERS AND THEIR USE IN URANIUM PROSPECTION. Robertson, D. S. (Robertson and Associates Ltd., Toronto). pp 495-512 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Pyritic, uranium-bearing, quartz-pebble conglomerates have been found in Canada, in South Africa, in Brazil, and in Australia. All are similar in lithology and mineralogy. All overlie a contorted greywacke-greenstone sequence and are overlain by rock units containing red clastics and shales. All are of similar age, where datable, being developed between 2800 my and 2200 my. Uranium content derives from detrital, heavy minerals carried to and preserved in the rocks because of an anoxygenic atmosphere prior to 2200 my. Recognition of the environment of origin reflected by the conglomerates or the change in environment reflected by the sequence of rock units described permits assignment of an age range, frequently more meaningful than that derivable from usual dating methods. Uraniferous conglomerate ores can only be found below the oldest red-colored rock units. (auth)

33078 REVIEW OF CURRENT CONCEPTS REGARDING VEIN DEPOSITS OF URANIUM. Smith, E. E. N. (Eldorado Nuclear Ltd., Ottawa). pp 515-529 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The primary uranium mineral filling cracks, fissures, pore spaces, breccias, and stockworks is pitchblende, a thorium-deficient variety of uraninite. A wide range of rocks may contain vein uranium suggesting that, in some cases, it is the structural trap created by the rock rather than its chemical composition which makes it a suitable host. Vein deposits form an integral part of the uranium geochemical cycle which includes all types of uranium deposits, and which governs the repeated transport and deposition of uranium from one geological setting to another. Because of this cyclic interdependence, different types of deposits may be found together within a specific uranium province. In Canada, uranium in veins, pegmatites, and sediments may all be found in the geosynclinal belts surrounding provinces and sub-provinces of the Precambrian shield. More than one type is invariably present within a small area, although all types may not form ore bodies. Age determinations on several deposits within a specific setting often indicate a long period of repeated concentration, transportation and redeposition such that the same uranium may have occupied different deposits during different periods of the cycle. Two major periods of the earth's geological history appear to have provided the original setting for most of the world's deposits of uranium in veins. These are the Carboniferous-Permian period and the Middle Proterozoic period. In both cases the first vein pitchblende was deposited during a period of long and intense weathering. Some geologists feel that repetition of these exogenic conditions has moved and redeposited the uranium several times up to the present. Other geologists consider that the uranium is carried to its host from a fertile source by thermal waters which may originate from late stages of granitic evolution or from acid vulcanism. (auth)

33079 CONCEPTS OF SUPERGENE VERSUS HYPOGENE EMPLACEMENT OF URANIUM AT RABBIT LAKE, SASKATCHEWAN, CANADA. Knipping, H. D. (Gulf Minerals Canada Ltd., Toronto). pp 531-549 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The Rabbit Lake uranium deposit occurs in Lower Proterozoic metasediments below a major unconformity overlain by Middle Proterozoic sandstone. The metasediments were deformed and metamorphosed during the Hudsonian orogeny about 1800 million years ago. After peneplanation of the Hudsonian orogen surface, weathering generated a porous and permeable regolith of varying thickness which later was covered by sandstone and faulted up by a reverse fault. Primary uranium mineralization of massive and colloform pitchblende occurred about 1000 million years ago and has no relationship to the Hudsonian orogeny. The ore paragenesis is simple and monotonous. Only very few sulphides such as pyrite, marcasite and chalcopyrite are present and closely associated with pitchblende. The hypothetical process of ore emplacement is as follows. Uranium solutions entered a structurally high block of strongly brecciated and altered calcareous metasediments, and pitchblende was deposited on the surfaces of

fractures, vugs and pores. Calcite, massive and euhedral quartz and euhedral dolomite overlie the pitchblende and protected it partly from leaching. Some of the pitchblende was leached and re-deposited at varying periods in other parts of the ore body. This process is still going on. Alteration and uranium emplacement are related to the surface and do not extend more than 300 to 400 ft below the unconformity. Though paleotemperature determinations on gangue minerals indicate low to elevated temperatures, the results are at present equivocal. The bulk of the evidence favors a supergene emplacement mechanism for uranium at Rabbit Lake with later leaching and re-deposition of sooty pitchblende and rare coffinite. Hexavalent uranium minerals such as uranophane, sklodowskite, and boltwoodite occur only near the present surface. (auth)

33080 URANIUM MINERALIZATION IN THE RUM JUNGLE-ALLIGATOR RIVER PROVINCE, NORTHERN TERRITORY, AUSTRALIA. Dodson, R. G.; Needham, R. S.; Wilkes, P. G.; Page, R. W.; Smart, P. G.; Watchman, A. L. (Bureau of Mineral Resources, Canberra). pp 551-568 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Renewed interest in uranium exploration in northern Australia in the late 1960s led to the discovery of one of the most important uranium fields in the world. To obtain an understanding of the geological setting of the uranium deposits, and to provide guidelines for future exploration, the Bureau of Mineral Resources (BMR) undertook an investigation which included semi-detailed mapping, aided by geophysical surveys, isotopic dating, and stratigraphic drilling. From the results so far obtained and from the important data made available by mining companies engaged in exploration in the region, a pattern of uranium mineralization can be recognized, particularly in relation to the Lower Proterozoic sedimentation of the region. (auth)

33081 FLUID INCLUSIONS IN URANIUM ORES FROM INTRAGRANITIC DEPOSITS IN LIMOUSIN AND FOREZ (MASSIF CENTRAL, FRANCE). Poty, B. P. (Centre de Recherches Petrographiques et Geochimiques, Nancy); Leroy, J.; Cuney, M. pp 569-582 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974). (In French).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Fluid inclusion studies have been performed utilizing a variety of techniques (crushing stage, microthermometry, and gas chromatography) on samples from uranium deposits located in granites from Massif Central: Limousin and Forez. In Limousin uranium is mined from veins and in hydrothermally altered pods of the Saint-Sylvestre two-mica granite. Only the second type of occurrence has been studied. Fluid inclusions show that a clear relation exists between uranium grade and CO_2 concentration in the fluid, that boiling occurred at the time of trapping, and that deposition occurred at a temperature of 340 to 350°C and a pressure close to 700 to 800 bars. This strongly suggests transport of uranium as uranyl carbonate complexes, and a deposition due to unmixing of the solution. Reduction of the uranyl ion is not fully understood. A reaction coupled with oxidation of ferrous iron does not seem adequate since hematitic alteration is not ubiquitous. In Forez (Bois Noirs–Limouzat vein) a detailed paragenesis in six stages has been worked out. The deposition of quartz-marcasite-pitchblende and pyrite (1st stage), is followed by hematitic quartz (2nd stage). At that time pitchblende was slightly altered into coffinite and epidote + adularia grew in the surrounding rocks. Then banded smoky quartz (3rd stage), fluorite, carbonates, and whewellite (4th stage) were formed. A late generation of quartz + bismuthinite crosses most previous generations (5th stage) and supergene alteration during alpine orogeny and present time ended the evolution of this vein (6th stage). Characteristic fluids have been isolated for the first five stages. Temperatures and compositions varied quite widely and suggest a complex genesis for this vein-type deposit. Fluids associated with pitchblende deposition as well as those associated with bismuthinite are rich in CO_2 and suggest, as in the case of Limousin, transport of uranium through uranyl carbonate complexes. Reduction of the uranyl ion was probably controlled by a constituent of the solution. (auth)

33082 USE OF FLUID INCLUSIONS IN THE GENETIC STUDY OF VEIN DEPOSITS. Bossi, J. (Facultad de Quimica, Montevideo). pp 583-592 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The formation process of the properly uraniferous type of uranium vein deposits (according to Geffroy and Sarcia) is still under discussion. The systematic application of the study of fluid inclusions is proposed in order to contribute to the interpretation of the genetic process. The behavior of fluid inclusions of a vein deposit of lead-zinc in the south of the French Central Massif, which, in the author's opinion, is believed to be per descensum (deposited by solutions moving downwards) is taken as a model and it is proposed that such a criterion be applied to uraniferous deposits. The aim of the paper is to interpret the genesis of these uranium vein deposits, in the belief that this will be of great importance in assessing guides for provisional prospecting, once the theoretical conditions that control the supergenic process are known. (auth)

33083 ZLETOVSKA REKA URANIUM DEPOSIT. Radusinovic, D. (Inst. for Geological and Mining Exploration and Investigation of Nuclear and other Mineral Raw Materials, Belgrade). pp 593-601 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The Zletovska Reka uranium deposit is located inside the Tertiary volcanites which were produced during the final phase of volcanic activity in the Zletovo-Kratovo metallogenetic area. The uranium has most probably originated from a deep-seated magmatic source, activated after the consolidation of volcanites; accordingly, the uranium deposit is in a paragenetic rather than in a direct genetic relation with volcanites. The mineralization is controlled by the fault-type structures, and the ore bodies, mainly vein-type, are located inside the sheared zones. The deposit has been formed during the epithermal phase of hydrothermal activity, and during one of the last stages of the mineralizing processes. The uranium mineralization has been deposited subsequent to the main phase of sulphide mineralization, which produced the important lead and zinc deposits in the Zletovo-Kratovo area. The well-defined depositional succession, starting with copper, via lead-zinc, to uranium mineralization, has been observed. Such formation of mineral parageneses has been reflected in their definite zoning, indicating some sort of differentiation of mineralizing solutions which resulted in increased uranium concentration in the late stages of hydrothermal activity and formation of the Zletovska Reka uranium deposit. (auth)

33084 OTHER URANIUM DEPOSITS. von Backstroem, J. W. (Atomic Energy Board, Pretoria). pp 605-624 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

Other uranium deposits (group 4) includes deposits that could not readily be classified with groups 1, 2, and 3, in the classification of uranium ore deposits established by the International Atomic Energy Agency at Montreal in September 1972. This group makes provision for many diverse types of uranium mineralization, and deposits are classified according to origin as orthomagmatic; diatremes; shear zones and breccias; supergene; brines; marine. A number of representative uranium deposits from each group are described. Orthomagmatic deposits cover uranium mineralization associated with granites, syenites, carbonatites and pyroxenite in Scotland, Alaska, Greenland, Brazil, South Africa, Madagascar and the United States of America. Uranium mineralization associated with diatremes in the United States of America, Canada and Italy, is described. Occurrences associated with shear zones and breccias in the two first-named countries and in India are also described. Examples are given of supergene deposits occurring in Canada, Portugal, Spain, Australia and Southern Africa, and of brines in the United States of America. Conditions for the formation of uranium deposits in closed basins are also mentioned. Finally, under uranium of marine origin a summary on uraniferous phosphatic rocks is quoted. The paper concludes with a description of some continental shelf deposits. (auth)

33085 URANIUM RESOURCES OF THE FUTURE: PORPHYRY URANIUM DEPOSITS. Armstrong, F. C. (Geological Survey, Spokane, WA). pp 625-635 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The economics of the electrical utility industry indicate that nuclear fuels will largely replace fossil fuels in large generating plants of the future. This use will cause a large demand for uranium; it will also cause the price of U_3O_8 to increase perhaps as much as threefold, and will release fossil fuels for other more beneficial uses. In the next quarter century, the uranium mining industry will probably undergo changes similar to those experienced by the copper mining industry in the last half century.

With increased price and large assured market, deposits containing as little as 0.04% U_3O_8 will become economically exploitable, and the large sums of capital necessary for their development will become available. Deposits containing 0.03 to 0.05% U_3O_8 occur in late magmatic differentiates. Alaskite, leucocratic granite, biotite granite, and biotite quartz monzonite that are intruded by networks of aplite and pegmatite dikes of similar composition are the favorable host rocks for porphyry uranium deposits. Uraninite and radioactive black minerals are the principal ores. Uranium also occurs as ionic and molecular disseminations. Possible examples of porphyry uranium deposits are Rössing, South West Africa; Charlebois Lake, Canada; Crocker Well, Australia; and certain areas in central Idaho and northeastern Washington. The deposits will be easiest to find in arid climates, and unmetamorphosed rocks are perhaps the most likely hosts. (auth)

33086 URANIUM OCCURRENCES IN BRAZIL. de Andrade Ramos, J. R.; Fraenkel, M. O. (Comissao Nacional de Energia Nuclear, Rio de Janeiro). pp 637-658 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The most important uranium occurrences in Brazil are discussed according to the following host-rock types: alkalic igneous, sedimentary, metaconglomerate, and granitic rocks. In the Pocos de Caldas Plateau there are uranium-molybdenum deposits which contain a reserve of more than 5000 t of U_3O_8. These zones are in addition to and separate from the caldasite occurrences often mentioned in the literature. The authors believe that these deposits are the result of concentration of uranium leached from metamict zircon crystals during hydrothermal alteration and weathering. In the Paraná Basin a reserve of 2000 t of U_3O_8 is estimated in the sandstones of the lower part of the Rio Bonito Formation (Middle Permian). The authors believe that this deposit was formed in a lithostratigraphic unit protected from surface oxidation by two impermeable strata, a coal seam below and limestone bed at the top. Since Permian time, ground-water flow within this confined hydrologic system has leached uranium and reprecipitated it in favorable locations. (auth)

33087 POSSIBLE METALLOTECTONIC CLASSIFICATION OF URANIUM DEPOSITS. Ziegler, V. (Commissariat a l'Energie Atomique, Chatillon, France). pp 661-677 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974). (In French).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The primary distribution of uranium and thorium is closely associated with the structural history of the sialic crust and hence with sialic magmatism. Accordingly, far from being distributed homogeneously, uranium should be associated preferentially with certain structural elements of the continental crust. Economic or subeconomic concentrations of uranium deriving for the most part from the primary distribution through hypogenic or supergenic remobilization should also be distributed in fairly close association with these structural elements. The author proposes a metallotectonic classification in the form of a table in which the deposits are grouped according to both the metallogenic type to which they belong and to the main structural element with which they are associated; the relative ages of the minerals are also indicated. From this table, which is based on the principal known occurrences of uranium in the world, it is possible to see the main characteristics of the distribution of uranium deposits. The chief purpose of the table is to indicate the principles of a method for studying the distribution of uraniferous deposits. Drawn up for a particular region, with appropriate structural and metallogenic distinctions, such a table should make it possible to discern the far more detailed regional patterns which are called for in the search for deposits. (auth)

33088 TECTONOMAGMATIC CONDITIONS OF URANIUM DEPOSIT FORMATION IN ROMANIA. Nitu, G. (Ministre des Mines, du Petrole et de la Geologie, Bucharest). pp 679-692 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974). (In Rumanian).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The age relationships between different tectonic, magmatic, and mineralization phenomena, the position of uranium deposits in the geological evolution of different regions, the relationship between Laramian magmatism and tectonics, the paleotectonic conditions of deposit formation, and the types of deposit characteristic of certain geological conditions are discussed. On the basis of this analysis, the author tries to derive certain rules, or to formulate and in part justify a number of hypotheses, concerning the role of magmatic and tectonic activity in the formation of Romania's uranium deposits, the depth at which they occur, the relief at the time of their formation, the reasons for the diversity of deposit types and for the occurrence of deposits including solid asphalts (anthraxolites), and the possible origin of the metals and asphalts. (auth)

33089 REPORTS OF THE WORKING GROUPS. pp 693-728 of Formation of Uranium Ore Deposits. Vienna; International Atomic Energy Agency (Nov 1974).

From symposium on the formation of uranium ore deposits; Athens, Greece (6 May 1974). See STI/PUB-374; CONF-740587-.

The chemical and physical mechanisms which permit uranium to be accumulated in solutions or melts, transported and precipitated, particularly at sufficient grades and tonnages to be of economic value are reviewed. It was concluded that controls for uranium mineralization that can be recognized in the field or laboratory should be quantified and interpreted in the context of chemistry, physics, geochronology, mineralogy, and isotope studies. Mineralogy encompases both chemical and physical parameters and can provide information not otherwise obtainable on the origin of a deposit. Such studies can also provide evidence on whether the present-time mineralization is original or has been subjected to remobilization during subsequent orogenic and/or metamorphic events. (CH)

33090 ANTAGONISM OF RADIOACTIVE ELEMENTS IN FIELDS OF ALTERNATIONS ACCOMPANYING ORE BODIES AND ITS USE IN AERIAL GAMMA SPECTROMETRIC EXPLORATION. Ostrovskij, E. Ya. Sov. Geol.; No. 10, 99-107(1973). (In Russian).

For English translation see the journal Int. Geol. Rev.; 34 refs.; 6 figs.

A new treatment is proposed for a number of changes in fields from ores, in which an enrichment in thorium, uranium (radium) or potassium occurs; there is an antagonism of thorium and uranium on the one hand, and of potassium on the other. This antagonism is particularly sharply expressed in the process of potassium- or sodium-alkali metasomatosis, with which the largest number of known, endogenous ore deposits is connected. The efficiency of using the antagonism of radioactive elements in aerial gamma survey spectroscopy is shown. The principle of low-probability of an aerial gamma search is presented in correspondence with which the accumulation of Th, U(Ra) or K is also considered to be a radioactive anomaly, when gamma radiation of a certain composition τ_1[Th, U, K] falls in a region of low-probability distribution values for a three-dimensional background vector R[Th, U, K] which characterizes the radioactive medium in which the aerial survey is conducted. (tr-auth)

33091 DOWNWARD ZONING OF MOLYBDENUM-URANIUM DEPOSITS. Modnikov, I. S.; Skvortsova, K. V. Geol. Rud. Mestorozhd.; No. 2, 51-59(Mar 1974). (In Russian).

For English translation see the journal Geochem. Ind.

Consideration is given to the results of a study of the regularities in the distribution of uranium and molybdenum in ores associated with vulcanic-plutonic formations. For these deposits a general regularity is characteristic in the vertical distribution of the main ore components which is expressed in an increasing ratio of uranium to molybdenum, lead, arsenic and zinc with depth. The presence of individual cases of reverse zonality (an increase in molybdenum content with respect to uranium at deeper layers) is caused by the precipitation of additional amounts of uraninite (pitchblende) with the sulfide metals after the uraninite–molybdenum stage. The effect of vulcanic structures, which are characterized by a different geologic-structural position, on the process of mineral formation is shown. In particular, for vulcanic structures of the overlapping type it is characteristic to find an intensive development of pre-mineral, hydrothermal changes in mineral-intrusive ores, significant vertical mineralization, and a predominance of disseminated, streaked ores of uraninite–coffinite–molybdenite associations. For open structures it is characteristic to find weaker signs for pre-ore hydrothermal changes of intrusive ores, a small vertical mineralization development, a predominance of marcasite and veined ores of columnmorphic structures, and a predominance of uraninite-femolite association of minerals. (tr-auth)

33092 NATURAL RADIOACTIVE ELEMENTS AND THE PHYSICAL PROPERTIES OF THE MANTLE OF THE KOSHRABAT GRANOSYENITE MASSIF (WESTERN UZBEKISTAN). Karimov, Kh. K.; Zhokhov, G. A. (Ministry of Geology, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 9, 53-54(1974). (In Russian).

The concentration of U(Ra), Th, K, and Au in granosyenites of the Koshrabat massif was determined. Typical values obtained are tabulated. The density, magnetic susceptibility, and natural radioactivity were also determined. The results indicated that U

is contained primarily in rock-forming minerals. The boundaries of hypergenesis zones are fixed by the Th/U ratio. (JSR)

Radioactive Effluents

Refer also to abstracts 32461 and 33126.

33093 (HASL-291) HEALTH AND SAFETY LABORATORY ENVIRONMENTAL QUARTERLY, DECEMBER 1, 1974–MARCH 1, 1975. Hardy, E. P. Jr. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.). 1 Apr 1975. 235p. Dep. NTIS $7.60.

Separate abstracts were prepared for nine sections of the report. (HLW)

For abstracts of individual sections see: 32461, 32508, 33094, 33102–33104, 33126, 33127, and 33444.

33094 (HASL-291, pp I.110-I.126) TRANSURANIUM NUCLIDES IN THE ENVIRONMENT FROM MANAGEMENT OF SOLID RADIOACTIVE WASTE. Daly, G. H.; Kluk, A. S. (Div. of Waste Management and Transportation, Washington, DC). 1 Apr 1975.

In Health and Safety Laboratory environmental quarterly, December 1, 1974–March 1, 1975.

Up to 20% of solid radioactive wastes which have been generated at ERDA sites may be contaminated with TRU nuclides. Prior to the requirement for 20-year retrievable storage in March 1970, solid waste contaminated with TRU nuclides was buried with other radioactive waste at carefully selected locations. A total of about 900 kg of TRU nuclides are contained in just over 1 million cubic meters of radioactive waste at these locations. Approximately 760 kg of TRU nuclides are contained in the buried waste, while the remainder is contained in the stored waste. Another 80 kg of TRU nuclides are contained at the five commercial burial sites. All evidence to date indicates that TRU nuclides have not migrated significantly from their burial location. (auth)

33095 (JPRS-63367) TRANSLATIONS ON ENVIRONMENTAL QUALITY. Number 63. Translation of Monographs from Various Journals. 50p. NTIS $3.75.

The following topics are discussed: East Germany–Potsdam to expand lawn areas; Brazil–effect of prohibiting insecticides in Brazil discussed; Colombia–ten laboratories producing hazardous herbicides; air and water pollution measures taken in Moscow; ecological effect of supersonic transport questioned; Torzhok firms delay construction of purification system; water treatment plants for Volga, Ural Rivers described; conservation measures and lack of same reported; Bashkiriya, Chelyabinskaya O blasts fight pollution; France–environmental impact of nuclear power discussed; and controversy mounts over nuclear power program. (GRA)

33096 (ORNL-5016, pp 26-36) WASTE MANAGEMENT ANALYSES AND APPLICATIONS. Tamura, T.; Brinkley, F. S.; Duguid, J. O.; Farrar, D. T.; Francis, C. W.; Malone, C. D.; Sealand, O. M. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

The major emphases in waste management research are prevention and mitigation of adverse effects of nuclear wastes discharged into the environment. A source of ^{90}Sr in White Oak Creek is burial ground 4 which discharges the activity through ground water flow and for which the contribution to the total discharge was determined. Calculations of the ^{90}Sr discharge for the past 11 years were also made, using stream monitoring data. Predictive models for radionuclide movement through soils are being actively pursued. Although major waste-management problems associated with the nuclear industry are concerned with radioactive wastes, assessment of installations has revealed that pollutants other than radioactivity, for example, nitrates, require attention. Converting high-level nitrates to elemental gaseous nitrogen (>5000 ppM nitrate) by biological denitrification is the principal effort in this activity. An active program at ORNL is the development of a radioactive waste repository in geologic formations. Borehole plugging is one of the most important considerations since inadequate plugging could result in a conduit for percolating water which could find its way to the waste repository. The effort has been increased for this phase of the study; however, due to limited manpower and prior commitments, our participation has decreased. An expanded program plan for the effort was written, and advisory service for implementation of the effort is being provided. Two processes are under development at ORNL. The anaerobic upflow packed-bed bioreactor process (ANFLOW) can be used to provide fuel gas, fuel, or industrial intermediate conversion from liquid or slurried solid waste. The aerobic lignocellulosic compositing process (ALIC) can be used to treat solid wastes so that they can be used as either animal feeds or feed for an ANFLOW unit. Both of these processes have been designed to provide simple, low-cost methods which can be adapted to use currently available equipment. Thus, they can be readily scaled-up to meet current energy needs. (auth)

33097 (PB-230605) WATER RESOURCES ACTIVITIES IN THE UNITED STATES. Pollution Abatement: 86th Congress, 2nd Session. (Public Health Service, Washington, D. C. (USA)). Jan 1960. 45p. NTIS $5.25.

For Select Committee on National Water Resources (U. S. Senate).

Recognizing pollution abatement as a growing problem that must be dealt with if our needs for an adequate supply of water of adequate quality for all segments of our economy are to be met in future years, the Secretary of the Department of Health, Education, and Welfare prepared a report for the committee covering the present and future extent of water pollution hazards brought about by industrial and municipal sewage and other waste materials disposed of in water. The report covers recent trends in the production and treatment of wastes, the relationship of sediment loads in our rivers to other pollution, and views as to requirements and recommendations for pollution control measures needed between now and 1980. (GRA)

33098 (PB-231665) SUMMARIES OF FOREIGN GOVERNMENT ENVIRONMENTAL REPORTS. Number 22. (Environmental Protection Agency, Washington, D. C. (USA)). Jun 1974. 90p. NTIS $4.75.

Abstracts on environmental problems of air pollution, noise, pesticides, radiation, solid waste, and water pollution are presented. The report focuses on legislative, organizational, economic, and social aspects of environmental protection. (GRA)

33099 (WIS-SG-74-223) SCOUR AND DEPOSITION: CHANGES IN SEDIMENTATION AROUND A NUCLEAR POWER PLANT. Kohler, M. H.; Moore, J. R. (Wisconsin Univ., Madison (USA)). Sep 1974. 264p. Sea Grant Communication, Madison, WI.

As industrial use of the coastal zone increases, the impact of water discharges upon the environment is a critical question. The sedimentary regime of Lake Michigan between Two Rivers and Two Creeks, Wisconsin was investigated because two new nuclear power plants are located along this shoreline and discharge cooling water into the lake. One of them, Point Beach Nuclear Power Plant, began operating in late 1970, discharging cooling water at the littoral zone. The problem centered on the nature of man-induced changes in patterns of natural sediment dispersal, erosion and deposition, both offshore and on the beach, because of water jetted perpendicularly into the lake at the shoreline. Four surficial sediment types were found in the area. Desiccated red clay of Valderan age is exposed, with little or no recent sediment overlying it, along the shoreline north of Point Beach Nuclear Power Plant. This same red clay underlies the recent sediments of the area. Rocky gravel and gravelly sand are found in a lobate zone northeast of Two Creeks. Sand, predominately in the fine sand class, dominates the area south of Point Beach Nuclear Power Plant, from the shoreline to four miles offshore. Sand also extends northward in a band lakeward of the coarser sediments. Muddy sand is found about four miles offshore. As sorting increases and grain size decreases from north to south offshore, a north to south sediment transport is indicated. The sand offshore is predominately quartz, with potash feldspar more abundant than plagioclase feldspar. Diopside, augite, enstatite, hypersthene, hornblende, and magnetite are the principal minerals in the high density fraction. Pleistocene drift deposits bordering the lake are the source of the recent sediments. Background radiation measurements revealed that the clays and muddy sands produced the highest radioactivity levels. Gravelly sand had the lowest levels with sands having intermediate values. Natural cycles of erosion and deposition occur along the lake/land interface, but the configuration of the beaches tends toward an equilibrium state. Erosion of the land behind the beach, due to high lake levels and intense storm action, is a natural phenomenon. Along the shoreline lakeward of Point Beach Nuclear Power Plant, an anomalous area of sand deposition has formed since the power plant began operation. Because this deposition is unnatural and not in equilibrium with the natural lake environment, it has been identified as a favorable prospect for economic exploitation. To date, no environmental degradation, as measured in the form of increased shore erosion, has been found due to the anomalous area of sand deposition associated with the power plant discharge. One form of benthic life, the amphipod Pontoporeia affinis Lindström, was found during the sediment sampling. (auth)

33100 CYCLING OF ELEMENTS IN ESTUARIES. Wolfe, D. A.; Rice, T. R. (Atlantic Estuarine Fisheries Center, Beaufort, NC). Fish. Bull.; 70: No. 3, 959-972(Jul 1972).

Meaningful evaluation of the ecological stresses imposed by man's release of heavy metals or radioisotopes into estuaries requires an improved understanding of the interactions between the waste materials and the functional components of the ecosystem. The types of information required for the development of useful models for the cycling of contaminant metals (both radioactive and stable) in estuarine ecosystems are reviewed. With particular reference to the coastal plain estuaries of the southeastern U. S., the major reservoirs of those metals, the mechanisms and pathways of elemental transformation and rates of elemental turnover among reservoirs, and the responses of these processes and reservoirs to environmental change are discussed. A conceptual systems model is presented as the preliminary phase in the development of dynamic mathematical models of elemental cycling. (Pollut. Abstr.)

Radioactivity Monitoring and Transport

Refer also to abstracts 33033, 33098, 33486, 33488, and 35647.

33101 (EPA-600/4-74-004) PROCEEDINGS OF SEMINAR ON METHODOLOGY FOR MONITORING THE MARINE ENVIRONMENT, Seattle, Washington, October 1973. Verner, S. S. (Ed.). (Environmental Protection Agency, Washington, D. C. (USA)). Oct 1974. 433p. (CONF-7310106-). GPO $4.90.

Separate abstracts were prepared for two of the 20 papers included. Other papers discuss methods for monitoring chemical pollutants and microorganisms in the marine environment. (CH)

For abstracts of individual papers see: 33135 and 33142.

33102 (HASL-291, pp I.57-I.79) TRANSURANIC ELEMENTS IN MARINE ENVIRONMENTS. Bowen, V. T. (Woods Hole Oceanographic Institution, MA). 1 Apr 1975.

In Health and Safety Laboratory environmental quarterly, December 1, 1974–March 1, 1975.

Transuranic elements are present in marine environments as a result of six types of human activity: worldwide fallout, close-in fallout, the SNAP-9A burnup, pipeline disposal of reprocessing wastes, neutron capture by uranium in one-pass cooling-water reactors and the B-52 crash in Thule, Greenland. Distributions and movements of these nuclides from these introductions are being studied partly because the transuranic elements themselves are geochemically interesting, partly because they appear to serve as tracers for specific oceanographic processes, and partly because of concern that man is faced with the problem of disposal of rapidly increasing amounts of transuranics as radioactive waste, and that we must be able, soon, to predict the fates and the effects of those amounts that reach the coastal waters or the deep oceans. Plutonium and americium are widely distributed in the oceans as a result of man's activities. Both appear to be more mobile than expected, and Pu shows little behavior in these environments that had been predicted from laboratory studies. Although their associations with biological material seem to be most striking for rooted plants or Sargassum, it is too premature to dismiss the possibility of their being a real hazard to marine life. For all the abundantly produced transuranics (neptunium, plutonium, americium, and curium) many more data are needed. (auth)

33103 (HASL-291, pp I.104-I.109) TRANSURANIUM ELEMENTS ON LAND. Harley, J. H. 1 Apr 1975.

In Health and Safety Laboratory environmental quarterly, December 1, 1974–March 1, 1975.

It is possible that with the increased development of light-water and breeder reactors we will be entering into a plutonium economy. Plutonium and its related transuranium elements are all extremely toxic and it is necessary to improve our understanding of their behavior in the environment. We presently have plutonium deposited on the earth's surface as a result of nuclear weapons tests, as a result of failure of a SNAP power source, and as a result of releases from nuclear processing facilities. There has been a concerted effort to use this deposited material to determine the transfer of plutonium through the environment and to estimate its uptake by man. This has required the development of sensitive analytical methods and very sophisticated counting equipment, since measurements for scientific purposes must be considerably more accurate than those merely designed to fulfill monitoring needs. The three sources can be looked at separately since the SNAP device was ^{238}Pu and the weapons debris and production material differ in isotopic composition. Mixtures are difficult to resolve to better than about ±25%, but some useful data are available. (auth)

33104 (HASL-291, pp II.1-II.74) HASL FALLOUT PROGRAM DATA. 1 Apr 1975.

In Health and Safety Laboratory environmental quarterly, December 1, 1974–March 1, 1975.

The following data are presented in the form of tables: monthly fallout of ^{90}Sr at world land sites; radionuclides and lead in surface air; Project Airstream; high altitude balloon sampling; ^{90}Sr in milk and tap water; ^{90}Sr in diet; and ^{90}Sr in human bone. (HLW)

33105 (HASL-291(App.)) APPENDIX TO HEALTH AND SAFETY LABORATORY ENVIRONMENTAL QUARTERLY, DECEMBER 1, 1974–MARCH 1, 1975. Hardy, E. P. Jr. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.). 1 Apr 1975. 474p. Dep. NTIS $10.60.

The following data are presented in the form of tables: ^{90}Sr and ^{89}Sr in monthly deposition at world land sites; radionuclides and lead in surface air; radiostrontium in milk and tap water; table of conversion factors; and table of radionuclides. (HLW)

33106 (HASL-292) INDEX OF INTERPRETIVE ARTICLES PUBLISHED IN THE HEALTH AND SAFETY LABORATORY FALLOUT PROGRAM, QUARTERLY SUMMARY REPORTS: 1958 THROUGH JANUARY 1, 1975. Volchok, H. L. (ed.). (Energy Research and Development Administration, New York (USA). Health and Safety Lab.). 1 Apr 1975. 79p. Dep. NTIS $5.45.

A list is presented of 357 reports published between 1958 and 1975 on monitoring of fallout of nuclear debris. The reports are organized into chronological, subject, and author listings. (CH)

33107 (JPRS-63418) TRANSLATIONS ON ENVIRONMENTAL QUALITY. Number 64. Translation of Monographs from Various Journals. 35p. NTIS $3.75.

The following subjects are discussed in the report: Bulgaria–progressive pollution of Black Sea causes grave concern; Poland–tasks of environmental control and research centers described; Romania–ministry of health measures for protection against radiation; Brazil–pollution damages fish production in Guanabara; pollution threatens freshwater shrimp; hazards of chemicals used to treat plants described; USSR–water treatment facilities in Estonia and Lithuania; industrial methods to reduce pollution; and Barsakel'mes animal preserve. (GRA)

33108 (LBL-2486) MONITORING RADIATION IN THE ENVIRONMENT DUE TO NUCLEAR REACTORS. Graven, R. M.; Budnitz, R. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 4 Jan 1974. Contract W-7405-eng-48. 61p. Dep. NTIS $6.25.

Nuclear reactors and the natural radiation background are discussed here with a view toward the instrumentation required to monitor radiation in the environment. A brief historical account of the use of nuclear reactors is presented to outline the magnitude of the environmental monitoring problem and its rapid rate of change. Various sources of radiation exposure are discussed, such as fuel handling, accidents, and waste storage. Measurement considerations and techniques used for area and environmental monitoring systems are briefly outlined. The natural background is described, including the radiation due to cosmic rays, external gamma rays, and internal exposures. A summary compares the instrumentation for monitoring natural radioactivity and radiation due to the nuclear fuel cycle. Government regulations are referred to and a variety of references are cited to provide both general and detailed technical information to guide the reader into the maze of available literature. (auth)

33109 (NIRS-RSD-38, pp 16-17) MONITORING POST. Nov 1973.

In radioactivity survey data in Japan.

Most of the monitoring posts in Meteorological Agency (Asahikawa, Wajima) and in 16 prefectures showed the same as normal value, except three sites (Asahikawa, Fukui, Tottori) which showed slightly high values. (auth)

33110 (NIRS-RSD-38, pp 18-20) DETECTION OF GIANT PARTICLES AND THE VALUES IN MILK, RAIN AND FALLOUT. Nov 1973.

In radioactivity survey data in Japan.

In relation to the 15th chinese nuclear explosion (Jun. 27, 1973), the activity of ^{131}I in milk and gross beta activity in rain and fallout were measured during July 1–17 at various places in Japan. The data and monitoring places were shown in tables and a figure. (auth)

33111 (ORNL-5016, pp 1-8) PART I. PLUTONIUM IN AQUATIC AND TERRESTRIAL ENVIRONMENTS. Dahlman, R. C.; Bondietti, E. A.; Eastwood, E. R. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

Research in environmental chemistry included PuO_2 studies using microspheres containing ^{238}Pu, ^{239}Pu, ^{240}Pu, and ^{241}Pu; interactions of Pu with environmental materials; gastrointestinal ad-

sorption and retention of Pu by channel catfish; and analytical chemistry of actinides in environmental samples. Studies on Pu in different contaminated environments included Pu in NTS soils; Pu in ORNL soil and mound sediments; concentrations of Pu in soil and vegetation of a floodplain; and transuranic elements in White Oak Lake. (HLW)

33112 (ORNL-5016, pp 13-25) PART II. ENVIRONMENTAL ASSESSMENTS: RADIOLOGICAL ANALYSES AND APPLICATIONS. Kaye, S. V.; Barton, C. J.; Booth, R. S. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

Progress is reported for the CUEX project, the Plowshare project, and special projects. The CUEX project includes dose estimation methodology; bioaccumulation factors for tritium and the radioisotopes of Cs, Sr, I, Mn, and Co; AIRDOS computer code; INREM and EXREM III computer codes; auxiliary computer codes; validation of environmental models; validation of atmospheric transport model; application of the CUEX computer code to the Haddam Neck Nuclear Power Plant; effect of stack height on dose estimation; and effect of uncertainties in deposition velocity on dose estimation. The Plowshare project includes a computer code for estimating doses from area sources; estimated radiation doses from food cooked with natural gas from nuclearly stimulated wells; and radiological assessment of ^{14}C releases to the environment. Special projects include nuclear fuel cycle project; radiological assessments for three-plant Oak Ridge environmental impact statement; radiological assessments of consumer products containing radionuclides; radiological assessments for LMFBR program environmental impact statement; preparation of annexes for ICRP draft report; and environmental transport of toxic chemicals. (HLW)

33113 (ORNL-5016, pp 63-64) PART IV. TERRESTRIAL ANALYSES, EFFECTS, AND MATERIALS TRANSPORT. Reichle, D. E. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

One of the objectives of the Ecosystem Analysis Program is to further understanding of how biological and physical processes interactively regulate the transport, fate, and effects of materials in ecological systems. The research program includes DBER projects (e.g., Radionuclide Cycling in Terrestrial Environments) and work-for-others activities (e.g., NSF-Biome Project and NSF-RANN Ecology and Analysis of Trace Contaminants). Research activities in the soils and sediments area have been focused on determining chemical forms of trace elements and processes leading to these forms in order to aid in the evaluation of biological availability and environmental transport. Biological transport studies have been designed to identify and evaluate the pathways and "sinks" of contaminants in both aquatic and terrestrial ecosystems. Applications of information from research programs have contributed to a number of technological assessment activities, including ^{14}C releases from HTGR fuel reprocessing facilities, Cr and Zn drift from cooling towers, evaluation of dispersion of F from uranium separations plants, trace element emissions from coal-fired power stations, and industrial trace element (Pb, Cr, and Hg) pollution of forested landscapes and reservoirs. Research is focused on three research sites. Results from research at Walker Branch Watershed, located on the AEC Oak Ridge Reservation, are providing characterization of trace element behavior on a landscape basis; parameterization of various submodels in the Unified Transport Model; and a base of information and experience that is being transferred to a similar research site in southeastern Missouri, the Crooked Creek Watershed located in the New Lead Belt of southeastern Missouri. Under NSF-RANN support we are determining the transport, distribution, and fate of Cd, Cu, Pb, and Zn which is deposited on this landscape from a lead mining-milling-smelting operation. In the TVA Holston River-Cherokee Reservoir system in east Tennessee we are studying the geochemical and biological transport of Hg from a defunct chloro-alkali plant in Saltville, Virginia. The emphases in this study are characterization of both inorganic and organic Hg in the bottom sediments, the suspended sediments, and the water column in terms of total water chemistry; and determination of both forms of Hg in fish, plankton, and benthic organisms living in these waters. (HLW)

33114 (ORNL-5016, pp 81-93) RADIONUCLIDE CYCLING AND EFFECTS. Dahlman, R. C.; Anderson, S. H.; Brinkley, F. S. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

Studies on radionuclide cycling in selected ecosystems included ^{137}Cs distribution in area contaminated by fallout simulant; flood plain research; relative concentrations of ^{137}Cs in soil and vegetation of the flood plain; distribution of ^{60}Co in the vicinity of a radioactive waste seep; ^{60}Co distribution in free-ranging mammals; food chain relationships at the ^{60}Co seep; and tritium concentration in a forest ecosystem contaminated by seepage. Microcosm research included studies on behavior of ^{129}I in soil and litter; and transfer of elements from decomposing detritus to green plants. Soil chemistry studies were conducted on selective adsorption of ^{137}Cs by naturally occurring clay minerals. Studies on environmental effects of cooling tower drift included predicted versus observed chromium in vegetation at ORGDP cooling towers; drift deposition measurements at the Paducah gaseous diffusion plant; and distribution of chromium in vegetation and small mammals adjacent to cooling towers. (HLW)

33115 (PB-237557) CHARACTERISTICS OF ATTACHED RADON-222 DAUGHTERS UNDER BOTH LABORATORY AND FIELD CONDITIONS WITH PARTICULAR EMPHASIS UPON UNDERGROUND URANIUM MINES. Open File Report, June 1972 – December 1973. Cooper, J. A.; Jackson, P. O.; Langford, J. C.; Peterson, M. R.; Stuart, B. O. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 14 May 1974. Contract H0220029. 285p. (BM-OFR-57-74). NTIS $8.75.

Results of this research will provide basic information on controlling radon daughter products in mine atmospheres through filtration. The objective was to study the characteristics of radon daughter products attached to aerosols under laboratory and underground mine conditions. This objective was achieved through identifications of typical aerosols and their chemical composition. The presence or absence of carcinogens other than alpha emitters was determined, and the information will be used for mine air filtration. It will be necessary to perform additional basic studies on the possible nuclear radiation exposure enhancement caused by diesel products inhaled by miners. No further work on attached radon daughters is needed in the foreseeable future; however, radon-222 absorption by airborne hydrocarbons and subsequent inhalation needs additional research. (GRA)

33116 (REG/G-4.1(Rev.1)(4-75)) PROGRAMS FOR MONITORING RADIOACTIVITY IN THE ENVIRONS OF NUCLEAR POWER PLANTS. (Nuclear Regulatory Commission, Washington, D. C. (USA)). Apr 1975. 4p. NRC.

This guide describes a basis acceptable to the NRC staff for the design of programs for monitoring levels of radiation and radioactivity in the environs of a nuclear power plant. (ERB)

33117 (SCPRI(RM)-7-1974) MONTHLY PROGRESS REPORT. (Service Central de Protection Contre les Rayonnements Ionisants, 78 – Le Vesinet (France)). Jul 1974. 11p. (In French). INIS.

Principal results concerning the surveillance of radioactivity in the environment are presented: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chain (milk, plants, cattle, fish), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are given in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U and T). A monthly bibliographic selection is also included. (FR)

33118 (SCPRI(RM)-8-1974) MONTHLY PROGRESS REPORT. (Service Central de Protection Contre les Rayonnements Ionisants, 78 – Le Vesinet (France)). Aug 1974. 11p. (In French). INIS.

This monthly report of the SCPRI includes an interpretation of the principal results concerning the surveillance of radioactivity in the environment: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chain (milk, plants, cattle, fish), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U and T). A monthly bibliographic selection is also included. (FR)

33119 (SCPRI(RM)-8-1974(APP.)) APPENDIX TO THE MONTHLY PROGRESS REPORT. Details of the Results of Measurements. (Service Central de Protection Contre les Rayonnements Ionisants, 78 – Le Vesinet (France)). Aug 1974. 21p. (In French). INIS.

Measurement tables concerning the surveillance of the environment (see also the SCPRI-RM-8-1974 report) are presented. (FR)

33120 (SCPRI(RM)-9-1974) MONTHLY PROGRESS REPORT. (Service Central de Protection Contre les Rayonnements Ionisants, 78 – Le Vesinet (France)). Aug 1974. 13p. (In French). INIS.

Principal results concerning the surveillance of radioactivity in the environment are presented: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chains (milk, plants, cattle, fish), sea water around nuclear plants sites and other

sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{89}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U and T). A monthly bibliographic selection is also included. (FR)

33121 (SCPRI(RM)-9-1974(APP.)) APPENDIX TO THE MONTHLY PROGRESS REPORT. Details of the Results of Measurements. (Service Central de Protection Contre les Rayonnements Ionisants, 78 – Le Vesinet (France)). Sep 1974. 23p. (In French). INIS.

Measurement tables concerning the surveillance of the environment (see also the SCPRI-RM-9-1974 report) are presented. (FR)

33122 (SCPRI(RM)-10-1974) MONTHLY PROGRESS REPORT. (Service Central de Protection Contre les Rayonnements Ionisants, 78 – Le Vesinet (France)). Oct 1974. 11p. (In French). INIS.

This monthly report of the SCPRI exposes an interpretation of the principal results concerning the surveillance of radioactivity in the environment: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chain (milk, plants, cattle, fish), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{89}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U and T). A monthly bibliographic selection is also presented. (FR)

33123 MONITORING OF ENVIRONMENTAL RADIATION. Okano, M. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Genshiryoku Kogyo; 20: No. 5, 15-18(May 1974). (In Japanese).

The purpose of environmental radiation monitoring is two-fold. One is the evaluation of exposure received from environmental radiation, and the other is the grasp of information on the causes of environmental radiation. The latter includes not only monitoring the artificially generated radiation as a result of the peaceful use of atomic energy, but the information of increased radiation due to nuclear explosion as well as natural radiation. Gamma spectrometry plays an important role in grasping the information on environmental radiation. Continuous monitoring is also an important means. Not only simple measurements but patterns of change are significant. To date, the monitoring target has been 500 mrem in the circumference of nuclear facilities. However the dose of 5 mrem per year has recently been proposed around light water reactor power plants, based on as low as practicable concept. Accordingly, monitoring cannot but be conducted by the method adapted to it. This therefore indicates the difficulties in traditional concepts in the normal environmental conditions that count up to 100 mrem per year of natural radiation. (JA)

33124 MEASUREMENT OF RADIATION EXPOSURE IN GENERAL ENVIRONMENT. Abe, S. (National Inst. of Radiological Sciences, Chiba (Japan)). Genshiryoku Kogyo; 20: No. 5, 24-28 (May 1974). (In Japanese).

Radiation measurements in general environment, and its consideration and procedures are described. The main purposes of the measurements are discovering high radiation level regions, checking contamination, taking geographical distribution of radiation dose, estimation of people's exposure, and others. The number of measuring points must be determined by taking into consideration required accuracy and the dispersion of radiation distribution and fluctuation through preliminary examination or estimation, when representative value is necessary. If distribution patterns are necessary, the number of measuring points is determined by preliminary examination or estimation and required minimum identification range. Determination of timing for continuous measurement relates to accuracy and fast response. A margin of about 20% is necessary for the number of measuring points determined. For selection of measuring instruments, total accuracy including the whole variable range before entering the instruments and random fluctuation range of measuring system is required to be taken into consideration. Notices for selecting the measuring system and for measurement are listed. (JA)

33125 TRITIUM IN NATURE. 1. Origin, Distribution and Methods of Counting. Povinec, P. (Komenskeho Univerzita, Bratislava (Czechoslovakia). Prirodovedecka Fakulta). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; No. 13, 251-275 (1973).

The natural and artificial sources of tritium, its transport from the stratosphere to the troposphere, the hydrosphere and the biosphere, and the forms of tritium existence in reservoirs are studied. Methods of low-level tritium counting are discussed. The comparison of gas counters with liquid scintillation counters shows that the former is advantageous for use in measuring activity lower than 100 TU, the latter in measuring higher activity. (auth)

Atmosphere

Refer also to abstracts 32517 and 33030–33033.

33126 (HASL-291, pp I.5-I.18) QUANTITATIVE HEALTH ESTIMATES OF TRANSURANIC RELEASES. Barr, N. F. (Div. of Biomedical and Environmental Research, Washington, DC). 1 Apr 1975.

In Health and Safety Laboratory environmental quarterly, December 1, 1974–March 1, 1975.

Estimates are presented of potential consequences to human health from transuranium elements released during the generation of electricity by the liquid metal fast breeder reactor (LMFBR) fuel cycle. Direct inhalation of downward descending airborne particles is the dominant route of entry of transuranic elements into man. The fraction of material entering man in this way is estimated to be 4×10^{-8}. This appears to be an upper limit for the fraction which might enter man through inhalation of material resuspended into the atmosphere after deposition. Upper estimates for the fraction of released material that enters man through ingestion from the time of release to complete decay of the activity are made for the most significant radioisotopes of plutonium, americium, and curium. ^{241}Am is the largest contributor to dose by this pathway. Health effects estimates based on current metabolic data, ICRP dose models and the report of the committee on Biological Effects of Ionizing Radiation of the U. S. National Academy of Sciences, when combined with these pathway analyses, indicate that there are unlikely to be more than about 10^{-3} potential health effects for each 1000 megawatt electric year of power generated. (auth)

33127 (HASL-291, pp I.80-I.103) TRANSURANIUM ELEMENTS IN THE ATMOSPHERE. Thomas, C. W.; Perkins, R. W. (Battelle Pacific Northwest Labs., Richland, WA). 1 Apr 1975.

In Health and Safety Laboratory environmental quarterly, December 1, 1974–March 1, 1975.

The main release of transuranium elements to the atmosphere has been a result of nuclear weapons testing, particularly the high yield fusion bomb tests beginning with the Ivy Mike test in 1952. It has been estimated that approximately 300 kCi of $^{239-240}$Pu were deposited on the earth's surface through 1972. Approximately 17 kCi of ^{238}Pu was injected into the atmosphere of the southern hemisphere in April 1964 when a satellite containing a power source failed to achieve a stable orbit. Analysis of the debris of Ivy Mike and subsequent high yield nuclear weapons debris has shown transuranium elements up to mass 257. The amounts of these heavy radionuclides compared with $^{239-240}$Pu drop off rapidly with mass. However, there are very considerable amounts of ^{241}Pu and ^{243}Am, and the ^{241}Am after total decay of ^{241}Pu will actually exceed the $^{239-240}$Pu. On comparing the airborne $^{239-240}$Pu to ^{137}Cs, it is found that their ratio has been relatively constant for the last several years, thus one can use the atmospheric models which describe the behavior of the fission products in describing the movement of the transuranium elements. Thus, it is possible to predict what the deposition pattern of the transuranium elements has been from past nuclear tests on the surface of the earth. It has been estimated that the nuclear power industry will generate approximately 10^{9} curies of transuranium elements during the remainder of this century. While it is highly unlikely that a significant amount of this material can enter the atmosphere, this source needs consideration, particularly in view of the much higher levels of some of the transuranium elements than that of ^{239}Pu. (auth)

33128 (NIRS-RSD-38, pp 2-8) GROSS BETA-RADIOACTIVITY IN THE RAIN AND THE AIRBORNE DUST. Nov 1973.

In radioactivity survey data in Japan.

The 15th nuclear test of the People's Republic of China was carried out on June 27, 1973. It is believed that the test area was somewhere in the neighborhood of Lake Lop Nor (40°N, 90°E), about 4,000 km west-northwest of Tokyo. Slightly abnormal microbarographic disturbances caused by the nuclear test were observed at several stations in Japan. It is estimated from the air mass trajectory that the radioactive debris released in the troposphere first passed in an altitude of about 10 km (300 mb level) over central Japan two days after the explosion. The data of gross beta radioactivity obtained from the rains during the July 1–10 period and from the airborne dust during the June 28–July 11 period are shown. As seen in the table the radioactive dust flew in Japan from west to east, a relatively high gross beta-radioactivity value detected 2.4 pCi/m^{3} in Fukuoka on July 1, and 6.0 pCi/m^{3} in Sendai on July 4. Later in areas north of Kanto values returned to almost normal. However, western Japan had high values again on the July 6–8 period. A nation-wide distribution of the radioactive rain could not be obtained under the enforced observation network because of few rainfalls that reached measurable amounts of 1 mm/day. However, a relatively high value, 7.0 pCi/

cc, was observed in Wajima in the rains during the June 30–July 1 period, the maximum value, 12.0 pCi/cc, in Yonago during the July 1–2 period, and values ranging from 1.0 pCi/cc to 5.0 pCi/cc in various places by July 8. By July 9 the values of radioactive rain and dust returned to almost normal, which took a whole period of 8 or 9 days, characteristically a long period. This long period of the radioactive abatement is explained with the 300 and 500 mb charts as follows. From June 27 to July 2 westerlies were prevailing over Japan in which the fallout seems to have arrived over Japan in an altitude of 300 mb from just after the noon to the evening of June 29. From around July 3, however, a high pressure zone covered Korea through the Japan Sea, and the situation continued up to around July 7. This caused in the neighborhood of Japan prevailing easterly winds, which brought back to western Japan the fallout once passed through to the Pacific. Survey of gross beta-activity in rain and dry fallout has been conducted using the data from 13 stations of Japan Meteorological Agency. (auth)

33129 (NIRS-RSD-38, pp 9-10) GROSS BETA-RADIOACTIVITY IN UPPER AIR. Nov 1973.

In radioactivity survey data in Japan.

Since 1960, Research and Development H.O., Japan Defense Agency has measured the beta activity of dust in the lower layer of the stratosphere and tropopause using aircrafts as collectors. Samples were taken over three areas of Japan using dust samples attached under the aircraft wings. The sampling flights were made using two aircrafts at the same time, one of which made a normal sampling flight and the other only upward and downward flight. The differences between the amounts of radioactivity of samples collected by the two aircrafts are taken as the value at the flight altitude. Results obtained are shown. (auth)

33130 (NIRS-RSD-38, pp 11) GROSS BETA-ACTIVITY IN RAIN AND DRY FALLOUT. Nov 1973.

In radioactivity survey data in Japan.

Daily rain and dry fallout samples were continuously (from 9 a.m. to the next 9 a.m.) collected in a tray on the roof of the building of the National Institute of Radiological Sciences in Chiba City, to determine the gross beta-activity. Gross beta-activity was measured using the uranium oxide (U_3O_8) standard with a Geiger-Müller counter. Highly radioactive particles were not detected. Radioactivities of the samples were measured 6 hours after the time of collection of the samples. Results obtained during the period from June 28 to July 8, 1973 are shown in the table. (auth)

33131 (NIRS-RSD-38, pp 12) GROSS BETA-ACTIVITY IN AIRBORNE DUSTS. Nov 1973.

In radioactivity survey data in Japan.

Daily measurements of airborne dusts in surface air were made from June 28–July 10. This paper suggests that the counting values are slightly larger than a normal level. (auth)

33132 (ORNL-5016) ENVIRONMENTAL SCIENCES DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 30, 1974. Taylor, C. I. (Ed.). (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 185p. Dep. NTIS $7.60.

Separate abstracts were prepared for 17 papers. An additional paper is included on educational activities. (HLW)

For abstracts of individual papers see: 33096, 33111–33114, 33161, 33162, 33165, 33445, 33488, 33536, and 35694–35699.

33133 SPECIAL METHODS OF RADIOACTIVE FALLOUT MEASUREMENT IN IRAQ. Usacev, S. (Komenskeho Univerzita, Bratislave (Czechoslovakia). Prirodovedecka Fakulta). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; No. 13, 111-115 (1973).

Fallout values in Basra (Iraq) for the first half of 1970 are shown in tables. The measurements were conducted weekly in a water container with citric acid added. Paper of known dimensions coated with paraffin was used in sampling. The measuring equipment is described. (INIS)

Soil

33134 STUDY OF ^{137}Cs SORPTION ON THE SOIL SORPTION COMPLEX BETWEEN THE YEARS 1964 AND 1970. Csupka, K. (Krajska Hygienicka Stanica, Bratislava (Czechoslovakia)). Pol'nohospodarstvo; 20: No. 2, 114-122(1974). (In Slovak).

Effects of ^{137}Cs sorption on the colloidal complex of the soil and the mutual influence of the pair ^{137}Cs-K were studied after successive extraction of the soil by certain agents. The non-extractable residue was pyrogenated with carbonate and after mineralization the ^{137}Cs and potassium contents were determined. Of the total potassium content in the soil, the non-extractable form amounted to 83 to 98%. Of the total ^{137}Cs content in the soil (average value 355 pCi/kg of the soil), 28% was constituted by the non-extractable form. The correlation coefficients of the elements ^{137}Cs-K had the following values: Exchangeable K-exchangeable ^{137}Cs r = +0.517, exchangeable K-available ^{137}Cs (extractable in a boiling HCl) r = +0.525 and available K (extractable in a boiling HCl—total ^{137}Cs) (determined by carbonate pyrogenation) r = –0.396. (auth)

Water

Refer also to abstract 33100.

33135 (EPA-600/4-74-004, pp 231-241) MONITORING SEAWATER FOR RADIONUCLIDES. Kahn, B.; Montgomery, D. M. (Environmental Protection Agency, Cincinnati). Oct 1974.

From seminar on methodology for monitoring the marine environment; Seattle, Washington, USA (Oct 1973).

In proceedings of seminar on methodology for monitoring the marine environment.

Problems involved in the monitoring of seawater for radioactivity are caused by the fact that numerous radionuclides must be measured, the radionuclides are present in extremely low concentrations, some radionuclides take several chemical or physical forms in seawater, both horizontal and vertical sampling locations and sampling frequencies must be carefully selected, and potential radiological hazards usually arise from the concentration of radionuclides in biota exposed to seawater. It is concluded that an acceptable radiological monitoring program can only be prepared on the basis of extensive experience with both routine programs and research on radionuclide transport in the marine environment. (CH)

33136 ESTIMATION OF GROUNDWATER ACCESSION TO AND EVAPORATION FROM A SOUTH AUSTRALIAN LAKE USING ENVIRONMENTAL TRITIUM. Allison, G. B. (CSIRO, Glen Osmond, Australia). Aust. J. Soil Res.; 12: No. 2, 119-131 (Dec 1974).

Groundwater throughflow in a small lake (volume = 9.6×10^4 m^3), which penetrates a limestone aquifer in southern Australia, is estimated to be about 3.0×10^4 m^3/yr. To make this estimate, use was made of both a short-term and a long-term tritium balance for interpreting the environmental tritium concentration of lake water and surrounding groundwater. This value compares well with estimates made using groundwater isopotentials and lake and groundwater chemistry. Knowledge of the groundwater component of the water balance has enabled an estimate of lake evaporation to be made. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 33538, 33542, 33543, 35687, and 35701.

33137 (BNWL-1950(Pt.2)) PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1974 TO THE USAEC DIVISION OF BIOMEDICAL AND ENVIRONMENTAL RESEARCH. Part 2. Ecological Sciences. Vaughan, B. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1974. Contract AT(45-1)-1830. 250p. Dep. NTIS $7.60.

Separate abstracts were prepared for seven sections of this report. A list is included of 85 publications during the period covered. (CH)

For abstracts of individual sections see: 32507, 32753, 33138–33141, and 33538.

33138 (BNWL-1950(Pt.2), pp 1-19) ANALYSIS OF NATURAL SYSTEMS. Dec 1974.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological Sciences.

The usefulness of kinetic models for monitoring changes in aquatic pollution is discussed. The use of computer calculations to predict the uptake and retention of DDT and ^{65}Zn in fish is cited as an example. A stratified random sampling program (FIDLER) was used to estimate the geographical distribution of activities from ^{239}Pu and ^{240}Pu in surface soil and vegetation at the Nevada Test Site. Models and procedures used for studies of fallout ^{137}Cs transport through the forage-cattle-milk food chain and lichen-caribou-Eskimo food chain in Alaska are described. The statistical and mathematical aspects of sampling programs for ecological studies and data acquisition and analysis systems are discussed, with emphasis on methods for the evaluation of the impact of nuclear power plants on the environment and the radiation dose to human populations. (CH)

33139 (BNWL-1950(Pt.2), pp 67-106) FRESHWATER SCIENCES. Dec 1974.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological Sciences.

Results are reported from studies on the effects of thermal effluents on the incidence of diseases, behavior and sensory physiology of fish in the Columbia River, the combined effects of chemical pollution and temperature on the incidence of diseases in fish, and the effects of tritium irradiation during embryogenesis on immune reactions in trout. The physicochemical characteristics of radionuclides in Hanford N-reactor effluent water discharged to a seepage trench were studied as they percolated through soil and emerged in seepage springs along the bank of the Columbia River, with emphasis on the biological availability and geochemical reactivity of ^{60}Co, ^{103}Ru, ^{106}Ru, ^{122}Sb, ^{124}Sb, and ^{125}Sb present in reactor effluent water partitioned among particulate, cationic, anionic, and nonionic species. Results of an aerial survey of salmon spawning in the Hanford reach of the Columbia River during 1974 are compared with surveys made in previous years. Results are reported from a study of the combined effects of water temperature and γ radiation on the survival of rainbow trout. The uptake and retention of ^{137}Cs and ^{65}Zn by periphyton in the Columbia River and the ratios of ^{238}Pu to ^{239}Pu, ^{240}Pu, and ^{241}Am in biota and sediments in a Hanford waste pond were determined. (CH)

33140 (BNWL-1950(Pt.2), pp 107-152) MARINE SCIENCES. Dec 1974.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological Sciences.

The HAPO Marine Research Laboratory, Sequim, Washington, is described and preliminary results are reported from a study of the physical, chemical, and biological characteristics of Sequim Bay. Results are reported from studies on: the effects of petroleum and petroleum products in effluents released to coastal waters on the ecology of animals and plants of intertidal communities; the uptake and retention of hydrocarbons by plankton; the effects of thermal effluents discharged from nuclear power plants to coastal waters on the number and occurrence of annelids, anthropods, and molluscs in marine communities; the effects of temperature changes on the growth and survival of shrimp (Pendelus danae); a literature survey on the distribution and effects of Cu on marine ecosystems; and the rates and mechanisms of air-seawater exchange and mixing of cosmogenic ^{7}Be, fission products, and Pu isotopes in fallout in North Pacific surface waters. A program, GEOSECS, was developed to characterize the biogeochemical and physicodynamic processes occurring in the oceans on the basis of chemical and radionuclide constituents. The distribution of Hg, Ag, and Co in the Atlantic and Pacific Oceans at various geographical and vertical levels was estimated using the GEOSECS sampling program and neutron activation techniques. A method was developed for the measurement of Se in seawater samples. Methods for measuring trace element and radionuclide pollution in marine sediments are discussed, with emphasis on ^{55}Fe in marine organisms. Data are included from studies on the concentration and distribution of ^{239}Pu and ^{241}Am in seawater, sediments, and marine organisms collected at Thule, Greenland and Eniwetok Atoll. (CH)

33141 (BNWL-1950(Pt.2), pp 157-207) TERRESTRIAL ECOLOGY. Dec 1974.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological Sciences.

Data are summarized on the ecology of wild animals and plants of the Hanford Reservation, with emphasis on populations of mule deer and birds. Data are included on the content of ^{95}Zr, ^{106}Ru, ^{137}Cs, and ^{144}Ce in the eggs of Canada geese nesting in the area; ^{238}Pu content in soils, forage, and field crops; the content of ^{129}I in litter and soil from grass and forest communities; the relationship of ^{129}I to stable ^{127}I in aquatic organisms and sediments; the content of ^{127}I and ^{129}I in the diet and tissues of swine in the area; and the content of ^{137}Cs in native residents of Anaktuvuk Pass, Alaska during 1969 to 1975. (CH)

33142 (EPA-600/4-74-004, pp 242-258) METHODS FOR MONITORING RADIOACTIVITY IN AQUATIC BIOTA. Nelson, V. A.; Schell, W. R.; Seymour, A. H. (Univ. of Washington, Seattle). Oct 1974.

From seminar on methodology for monitoring the marine environment; Seattle, Washington, USA (Oct 1973).

In proceedings of seminar on methodology for monitoring the marine environment.

Pertinent literature concerning methods for monitoring radioactivity in the aquatic environment is reviewed. Topics discussed include critical pathways for radionuclide transport through aquatic food chains, sampling methods, measurements of specific activities, chemical procedures, and radiometric procedures, with emphasis on radionuclides in seawater and coastal ecosystems. Two radiation monitoring programs are outlined. These include a comprehensive radiometric survey of air, water, soil, sediments, and biota samples collected during 1972 at Bikini and Eniwetok Atolls for the evaluation of the environmental safety of the sites of occupancy by human populations removed in 1946 prior to use of the area as a test site for nuclear devices. The program for monitoring the Washington Coast area for radionuclides in Hanford reactor effluents released to the Columbia River during 1944 to 1971 is also described. (CH)

33143 (LA-5883-PR, pp 46-62) ENVIRONMENTAL STUDIES. Feb 1975.

In biomedical and environmental research program of the LASL Health Division. Annual report, January–December 1974.

The research activities of the Environmental Studies Group include: environmental resources inventory; radiation ecology studies; Alaskan arctic ecosystem studies; and atmospheric transport studies. The environmental resources inventory includes: understory vegetation analysis; species diversity and composition of small mammal communities; radiotelemetry study of mammalian predators; soils of the LASL; and a National Environmental Research Park proposal. The radiation ecology studies include: honeybees as biological indicators of radionuclide contamination; radiation ecology studies of canyon liquid waste disposal areas; small mammal studies in Los Alamos liquid waste disposal areas; small mammal population densities and composition at Trinity site; distribution of Pu in Trinity soils; waste disposal canyon intensive site studies; and Rio Grand River studies. The Alaskan arctic ecosystem studies include: ecological investigations of Alaskan North Slope oil field development; and radiation ecology studies of northern Alaska. Terrain influence on low-level meteorological transport is the only atmospheric transport study discussed. (ERB)

33144 (NIRS-RSD-38, pp 14-15) IODINE-131 IN MILK. Nov 1973.

In radioactivity survey data in Japan.

Concentrations of iodine-131 in milk were determined by the National Institute of Radiological Sciences during the period June 28–July 17, 1973. Milk samples were raw milk, which were taken from a farm in the National Institute of Animal Industry located in the southern part of Chiba City. Iodine-131 was determined by "Milk matric" using 3φ × 3" NaI (TL) detector, 21 of Marinelli breaker and multi channel pulse height analyzer. According to the method, the detectable limit was 50 pCi/1. An example of gamma spectrum is shown and results obtained are shown. (auth)

33145 (SR-639-15) FLUX OF RADIONUCLIDES THROUGH A SALT MARSH. Progress Report, July 1, 1974–June 30, 1975. Pomeroy, L. R.; Odum, E. P. (Georgia Univ., Athens (USA). Dept. of Zoology). 15 Mar 1975. Contract AT(38-1)-639. 11p. Dep. NTIS $4.00.

Progress is reported on studies of exchange processes of radionuclides in salt marshes and microbial community processes on the continental shelf. Work on the exchange of phosphate between salt marsh sediments and estuarine water was also carried out on a seasonal basis. Instrumentation was developed for studies of the microbial and planktonic community of continental shelf waters, and some preliminary shake-down cruises were made in the Georgia bight. Work also was begun on a scanning electron micrographic study of the microorganisms and ultraplankton of the continental shelf. (auth)

33146 EFFECT OF PEAT AND IT ASH ON THE ACCUMULATION OF ^{90}Sr AND ^{137}Cs IN THE OATS YIELD. Gulyakin, I. V.; Mamontova, L. A. Dokl. TSKhA (Timiryazev. Sel'skokhoz. Akad.); No. 188, 125-129(1972). (In Russian).

Planting experiments were carried out over a period of two years with oats of the type Moscow A-315 on grass-podzolic, sandy loam soil. It was established that the use of turf and its ash decreases the accumulation of ^{90}Sr and ^{137}Cs in oats. (tr-auth)

33147 DATA FOR DETERMINATION OF THE DEPENDENCE OF RADIOACTIVE CONTAMINATION OF THE ENVIRONMENT ON THE AMOUNT OF FALLOUT. Szabo, A.; Bende, E. (Magyei Elelmiszerellenorzo es Vegyvizsgalo Intezet, Gyor, Hungary). Izotoptechnika; 18: No. 1, 9-13(Jan 1975). (In Hungarian).

The route of the contamination to the earth's surface and in plants is discussed. Metallolonic fraction activities of vegetables and fodders in Gyõr between 1968 and 1973 are described. A significant correlation between contamination and fallout can be observed. (auth)

Radiometric Techniques

Refer also to abstracts 32473, 32474, 32512, 33090, 33337, and 34238.

33148 (RLO-2213(Suppl. 2)) ECOLOGICAL TECHNIQUES UTILIZING RADIONUCLIDES AND IONIZING RADIATION. A Selected Bibliography. Schultz, V. (Washington State Univ., Pullman (USA). Dept. of Zoology). 1975. Contract AT(45-1)-2221. 71p. Dep. NTIS $5.45.

A selected bibliography containing citations to the literature on the use of radionuclides and ionizing radiation in ecological techniques is presented. The citations are arranged in alphabetical order by author. (ERB)

33149 Rb-Sr RADIOMETRIC STUDIES FOR THE DALHOUSIE AND ROHTANG AREAS, HIMACHAL PRADESH. Bhanot, V. B.; Goel, A. K.; Singh, V. P.; Kwatra, S. K. (Panjab Univ., Chandigarh, India). Curr. Sci. (India); 44: No. 7, 219-220(5 Apr 1975).

A part of the reconnaissance type of Rb-Sr whole-rock dating that has been undertaken at Chandigarh for the granitic and gneissic rocks of NW Himalayas is described. Two rock samples and one biotite sample were analyzed. The apparent ages of the samples, based on the isotope ratios, are given. (ERB)

33150 FISSION TRACK AGES OF SOME MUSCOVITES OF BIHAR MICA BELT. Virk, H. S.; Koul, S. L. (Punjabi Univ., Patiala, India). Curr. Sci. (India); 44: No. 7, 211-214(5 Apr 1975).

The fossil fission track technique has been used in dating Precambrian muscovite samples of Bihar Mica Belt (Kodarma, District Hazaribag). The average age obtained for this belt is 865 ± 72 million years which agrees with the age determined by radiometric methods. (auth)

33151 GAMMA-GAMMA METHOD IN DETERMINING ROCK DENSITY IN BORE HOLES. Wojda, F. (Przedsiebiorstwo Poszukiwan Geofizycznych, Warsaw (Poland)). Tech. Poszukiwan; 12: No. 47; 48, 1-12(1973). (In Polish).

Referring to the importance of knowledge of rock density in the interpretation of measurements made by means of drilling geophysical methods, and in the interpretation of the materials obtained by means of other geophysical methods (seismics, gravimetry), particularly during evaluation of the reservoir properties of rocks-the solution of this problem at the Enterprise for Geophysical Prospections is described. The article concerns the technical parameters of the probes used and some examples of the results of measurements. Moreover, a model site for calibration and a standarizer are described. (auth)

33152 CARBON-14 DATING OF GROUNDWATER FROM CLOSED AND OPEN SYSTEMS. Wigley, T. M. L. (Univ. of Waterloo, Ont.). WRERA; 11: No. 2, 324-328(Apr 1975).

Groundwaters may be dated by using carbon-14, provided that the raw data are properly adjusted. However, adjustment factors determined from geochemical or isotopic measurements and based on simple models of carbonate dissolution do not always agree with adjustment factors obtained by independent means. In this paper, established adjustment methods are reinterpreted in terms of closed and open system models of carbonate dissolution, and it is suggested that these models provide a sounder framework for determining adjustment factors. Hypothetical and real examples are considered, and it is shown that some otherwise anomalous results may be explained in terms of the closed and open system models. (auth)

33153 CONTINUOUS MEASUREMENT OF THE DIURNAL FLUCTUATION OF THE MASS OF A SINGLE CABBAGE PLANT. Wiebe, H. J.; Schaetzler, H. P.; Kuehn, W. (Technische Univ. Hannover (F.R. Germany). Inst. fuer Gemuesebau; Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Hannover (F.R. Germany). Inst. fuer Strahlenbotanik). Kerntechnik; 16: No. 12, 532-533(Dec 1974).

The gamma absorption method was used for the measurements. A scintillation detector and a gamma source (14 mCi of ^{241}Am) were attached to the opposite sides of a living cabbage head. The arrangement was done so as to allow an accuracy of mass determination of better than ±0.3%. The cabbage was located in a climate chamber in which temperature, humidity, and light conditions could be varied. The results indicated a significant influence of the periodical variation of the climate on the mass fluctuation. During constant climate the periodic fluctuations were very weak and no decrease of mass was observed. (GE)

33154 ISOTOPE DATING USING A PROPORTIONAL COUNTER. Chrapan, J.; Oravec, J.; Sitar, B.; Usacev, S.; Durcek, K.; Schmidt, Z.; Vaskovska, E. (Komenskeho Univerzita, Bratislava (Czechoslovakia). Prirodovedecka Fakulta). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; No. 13, 145-166(1973). (In Slovak).

The principles are given of age estimation using proportional counters, and results are presented of age estimation of soils and bones. (auth)

33155 ISOTOPIC HOMOGENIZATION DURING THE ANALYSIS OF THE GEOCHRONOLOGICAL SAMPLES. Zykov, S. I.; Stupnikova, N. I.; Smirnova, K. I.; Myasnikova, V. L. (Moskovskij Gosudarstvennyj Univ. (USSR); AN SSSR, Moscow. Inst. Geokhimii i Analiticheskoj Khimii). Izv. Akad. Nauk SSSR, Ser. Geol.; No. 4, 5-12(Apr 1974). (In Russian).

For English translation see the journal Bull. Acad. Sci. USSR, Geol. Ser.

Consideration is given to the isotopic method of determining the content of elements in geochronological samples. An isotopic method of calculating the content of elements in a sample is proposed by means of which it is possible for the investigator in each series of experiments to control the accuracy of carrying out the chemical and isotopic analyses, and also to detect element contamination from reagents during analysis so that it is possible to obtain more accurate values of the radiologic age. The isotopic method of calculation can be used in potassium-argon, rubidium-strontium and uranium-thorium-lead methods of dating minerals and ores. (tr-auth)

33156 MINIATURE PULSE NEUTRON WELL LOGGING INSTRUMENT. Galkina, E. B.; Golovanov, P. G.; Krivoplyasov, A. M.; Parkhomenko, Yu. N. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Yadernoj Geofiziki i Geokhimii, Moscow (USSR)). Geofiz. App.; No. 53, 58-61(1973). (In Russian).

Small-sized equipment intended for investigating mechanized oil boreholes by neutron surveying is described. The dimensions are decreased by increasing the feed potential (requiring special development of pulse transformers), changing the counting circuits, and also by changing the feed to the irradiator and counter from the surface. (tr-auth)

33157 THE EFFECT OF THE DEEP-HOLE FACTORS ON THE NEUTRON SLOWING-DOWN LENGTH IN OIL-BEARING- AND WATER BEARING RESERVOIRS. Kozachok, I. A.; Riznik, Sb., Akad. Nauk Ukr. SSR, Inst. Geofiz.; No. 56, 3-11(1973). (In Russian).

Consideration is given to the effect of deposit depth (down to 15 km) and of temperature (up to 450°C) on the neutron moderation length in oil-bearing and water-bearing collectors. Determination of the relative change in moderation length as a function of the depth factors is carried out in a P_3-approximation by the method of spherical harmonics. A digital computer was used to calculate the relative change in neutron, slowing-down length to energies of the indium resonance as a function of depth factors. The relative neutron, slowing-down length is given as a function of the density and concentration of a pore-saturating water-salt solution which is assumed to correspond to a depth of 10 to 15 km. The relative neutron, slowing-down length is calculated as a function of immersion depth. From the data conclusions are derived regarding the favorable effect of separate depth factors on the neutron slowing-down length in water-bearing and oil-bearing collectors. These changes in neutron moderation characteristics of oil-bearing and water-bearing collectors can be taken into account in interpreting the behavior of epithermal neutrons. (tr-auth)

33158 STUDY OF GROUNDWATER FLOW BY TRITIUM CONCENTRATION IN WATER. II. Analysis of Ground Water Flow of Inland Subsidence Area of Niigata. Kimura, S. (Agricultural Engineering Research Station, Hiratsuka, Japan). Nogyo Doboku Shikenjo Hokoku; No. 10, 1-42(Mar 1972). (In Japanese).

For the purpose of attaining wide applicability of the method of analyzing groundwater flow presented previously, some flow models and a new analytical method by tritium concentration in groundwater are proposed after theoretical and experimental studies in natural conditions. Then, analytical study of ground subsidence in Niigata province was carried out by these flow models. The natural groundwater flow is not represented by Darcy flow, but it is represented by Bingham flow. The new analytical method by tritium concentration (fallen time matching method) was applied also to the study of groundwater in the inland subsidence area of the same province. From the results of these studies, plausibility of the hypothetical flow models and general applicability of the new analytical method were almost ascertained. The fallen time matching method, above cited, makes it possible to know time passage after rain fall and proportion of high T-concentration flow to whole water, by superimposing result of T-concentration measurement upon the trend of changing T-concentration of rain water in course of time. (JA)

33159 ^{14}C AGE OF ALLUVIUM IN YOKOKURA, TSUNODA CITY, MIYAGI PREFECTURE. ^{14}C Age of Japanese Quaternary Strata, 100. Takeuchi, T.; Okutsu, H. Chikyu Kagaku; 28: No. 4, 150-151(Jul 1974). (In Japanese).

Tsunoda basin situated at the northern end of Abukuma mountainous district consists mainly of alluvial field, and terrace

groups distribute only fragmentarily on edging parts. According to Yoshida et al., the alluvial surface in Tsunoda basin is divided into two levels, and on the surface of the lower level, the trace of meander remains. The sampling place Yokokura is located at the north-western edge of the basin, and near the end of the alluvial field penetrating in hilly district. According to the boring core samples obtained here, the alluvium around here gets on Miocene unconformably, and comprises the peaty clay layer in which three layers of peat are inserted. The result of pollen analysis of the boring cores showed the pollen composition of mainly Quercus, Carpinus, and Coriaria at low level, and that of Cryptomeria and Pinus at upper level, through that of Quercus, Carpinus, and Alnus at intermediate level. The measurement of ^{14}C age of the peaty soil was carried out by Professor Kigoshi, and the result was 4,930 ± 160 years BP at low level, and 770 ± 140 years BP at upper level. According to the result, the deposition age of the alluvium in this area is unexpectedly new. (JA)

33160 DISTRIBUTION OF SULFUR ISOTOPES IN THE RYUSEI VEIN OF THE AKENOBE MINE, HYOGO PREFECTURE, JAPAN. Yamamoto, M. (Okayama Univ. (Japan). Faculty of Science). Geochem. J. (Nagoya); 8: 75-86(Jun 1974).

Sulfide samples (mostly chalcopyrite with some sphalerite and bornite) from the Ryusei vein of the Akenobe mine exhibit a narrow spread in $\delta\ ^{34}S$ value ranging from −4.4 to −0.4‰. The range is lower than those of other Japanese sulfide deposits so far studied. The frequency diagram of $\delta\ ^{34}S$ values for chalcopyrite indicates that the $\delta\ ^{34}S$ distribution is bimodal; one peak at −3.0 to −2.5‰ and the other at −1.5 to −0.5‰. This suggests that chalcopyrite in the Ryusei vein was formed in at least two different stages of mineralization. Of 9 sphalerite-chalcopyrite pairs studied (including 2 pairs from different veins), 8 pairs are isotopically in disequilibrium; sphalerite is up to 2.7‰ lighter than coexisting chalcopyrite. From the isotopic and chemical equilibrium relationship between the aqueous and mineral species of the Cu−Fe−S−O system, $\delta\ ^{34}S$ values of the ore-forming solutions were speculated to be rather similar to those of chalcopyrite (0 to −5‰). (auth)

Site Surveys

Refer also to abstracts 33137 and 33138.

33161 (ORNL-5016, pp 65-72) EASTERN DECIDUOUS FOREST BIOME: OAK RIDGE SITE. Harris, W. F.; Anderson, R. M.; Ausmus, B. S. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

Progress is reported on the following research projects: forest abiotic energy balance; estimates of nitrogen losses from litter; application of factor analysis to decomposition studies; TEEM; terrestrial ecosystem energy model; a model of calcium-cycling in an east Tennessee forest; and a theoretical basis for ecosystem analysis. (HLW)

33162 (ORNL-5016, pp 103-113) REGIONAL ENVIRONMENTAL ASSESSMENT. Reichle, D. E.; Anderson, S. H.; Dixon, K. R. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

Criteria are being developed for determining appropriate mixes and trade-offs between nuclear and non-nuclear power generating facilities to determine future energy development strategies. Progress is reported on the following studies: atmospheric distribution of sulfur dioxide; assessment of ecological effects; regional hydrologic simulations; regional vegetational analysis; assessment of wildlife effects from land-use alteration; and environmental effects of Appalachian coal extraction. (HLW)

33163 (SCP-2.28.05-2) ATMOSPHERIC DISPERSION AND RADIATION DOSE CALCULATIONS FOR NUCLEAR POWER PLANT: SUPPLEMENTARY REPORT. Meteorological Conditions, Prospective Site: Saga (Porsgrunn). Killerud, K.; Sivertsen, B.; Dovland, H. (Scandpower A/S, Oslo (Norway)). June 1974. 33p. (In Norwegian). Dep. NTIS (US Sales Only) $5.00.

The meteorological data on which the atmospheric dispersion and radiation dose calculations for the Saga proposed nuclear power plant site near Porsgrunn on the Outer Oslofjord are presented. Following a general presentation of the climatic conditions in the Oslofjord region, the data for wind and its stability are discussed. Data for accident situations and normal operation are given and comments made on the persistence of wind direction and stability, and dispersion parameters and their accuracy. Data are presented in tabular form and on maps. (NO)

33164 CADMIUM, LEAD, AND ZINC DISTRIBUTIONS BETWEEN EARTHWORMS AND SOILS: POTENTIALS FOR BIOLOGICAL ACCUMULATION. Van Hook, R. I. (Oak Ridge National Lab., TN). Bull. Environ. Contam. Toxicol.; 12: No. 4, 509-512(1974).

Thermal Effluents

Refer also to abstracts 33099, 33132, 33140, and 35552.

33165 (ORNL-5016, pp 39-49) PART III. AQUATIC STUDIES: POWER PLANT EFFECTS. Coutant, C. C.; Carroll, D. S.; Cox, D. K. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

Studies on effects of temperature transients included: thermal tolerance of the Asiatic clam; thermal resistance of juvenile crayfish; cold shock effects on susceptibility of juvenile channel catfish to predation; and resistance of gizzard shad to instantaneous cold shock. Studies on behavior responses included: field temperature selection by fish; analysis of winter body temperatures of gizzard shad; and stage selective predation of bluegill fry on copepods. Studies on production responses included measurement of filtration rate by molluscs and growth, consumption, and conversion rates as a function of temperature of subadult striped bass. Other studies were conducted on field surveys at the Kingston steam plant, survival of juvenile fishes in a simulated condenser, and striped-bass population modeling. (HLW)

33166 (PB-230733) WATER QUALITY REQUIREMENTS FOR ATLANTIC SALMON. Decola, J. N. (Federal Water Quality Administration, Needham Heights, Mass. (USA). New England Basins Office). Aug 1970. 56p. (CWT-10-16). NTIS $6.00.

The water quality requirements of Atlantic Salmon are discussed under the following headings: summary; dissolved oxygen requirements; temperature requirements; and other environmental factors. (GRA)

33167 (PB-236034) SOCIO-ECONOMIC IMPACT OF ESTUARINE THERMAL POLLUTION. Completion report. Williams, J. S. Jr.; Spigel, S. (Metrostudy Corp., Washington, D. C. (USA)). 1974. Contract DI-14-31-0001-9059. 124p. NTIS $5.25.

The impact of thermal pollution from a nuclear power plant on people is indirect and is mediated by the perceived economic impact as well as the perceived environmental impact. Attitudes toward the power plant are primarily a function of the economic impact and secondarily a function of environmental attitudes. Residents who felt they derived economic advantage from a power plant tended to deny any adverse environmental impact. While strong feelings toward nature were associated with negative attitudes toward construction of another nuclear plant, participation in a particular sport or recreational activity provided no basis for prediction of a favorable or unfavorable attitude to the plant. For the immediate area around the Barnegat Bay estuary, the economic analysis showed a favorable ratio of benefits to costs. (GRA)

33168 FUTURE POWER DEVELOPMENT AND ENVIRONMENTAL CONSERVATION. On Heated-Water Discharge. Wada, A. (Central Research Inst. of Electric Power Industry, Tokyo (Japan)). Seisan Gijutsu; 26: No. 3, 26-34(Mar 1974). (In Japanese).

Warm-water problem, i.e., thermal pollution by thermoelectric and nuclear power stations, is originated in condensers. This is enhanced recently because of their siting in remote areas, and local fisheries are adversely affected. The theoretical models for the problem must be in conformity with actual observation. As the measures to be taken, there are heat dissipation into the atmosphere, water intake from deep sea, and the mix-in cooling of heated water in the sea. The following matters are described: heated water and its regulation, research techniques, investigation on the diffusion of heated water, the measures to cope with the problem, and situations in overseas countries. (JA)

Chemical Effluents

Refer also to abstracts 33101, 33140, and 33378.

33169 (LBL-3223) CURRENT METHODS IN AIR QUALITY MEASUREMENTS AND MONITORING. Hollowell, C. D.; McLaughlin, R. D.; Stokes, J. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1974. Contract W-7405-eng-48. 15p. (CONF-741213-16). Dep. NTIS $4.00.

From nuclear science symposium; Washington, District of Columbia, USA (11 Dec 1974).

Methods for monitoring particulate aerosols, SO_2, NO_2, CO, and selected hydrocarbons in surface air are reviewed briefly. The characteristics of measuring instruments are discussed and National Primary Ambient Air Quality Standards are included. (CH)

INSTRUMENTATION

General Detectors and Monitors

Refer also to abstracts 33108, 33298, 33539, 33571, 33581, 33629, 33645, 34151, 35207, and 35598.

33170 (AD-786803) DOSIMETRIC AND RADIOMETRIC INSTRUMENTS, TEST METHODS. 7 Jan 1974. Translation of Russian State Standard Gost 17355-71, 11p. [nd]. (FSTC-HT-23-1439-73). 14p. NTIS $3.25.

The document presents specifications for testing dosimetric and radiometric instruments. Methods for calibrating the instruments against standard instruments or standard sources of ionizing radiation are presented. Determination of supplementary errors due to power supply voltage changes, high temperature, low temperature, humidity, pressure. radiation interference, magnetic field changes and changes in background radiation are presented or other specifications are discussed. (GRA)

33171 (AED-CONF-74-512-001) A PORTABLE MONITOR FOR THE LONG-TERM MEASUREMENT OF α-RADIOACTIVE AEROSOLS. Haider, B.; Jacobi, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz). 1974. 8p. INIS.

From annual meeting of the Gesellschaft fuer Aerosolforschung e.V.; Bad Soden, F. R. Germany (16 Oct 1974).

With abstract in German and English.

A new monitor for measuring the α-activity of aerosols has been developed. The instrument is equipped with a rechargeable battery and enables continuous or fractionated air sampling to be made at preset time intervals over a period of 1 to 2 weeks with one battery charge. The sampled α-activity is measured by a silicon-detector and counted electronically. The monitor is especially developed for continuous measurements of radon daughter activity in working areas of mines. The monitor also will be used in living rooms and laboratories. (auth)

33172 (KURRI-TR-115, pp 1-4) THE EFFECT OF TREATMENT OF ANALOGUE SIGNALS AND PROBLEMS IN THE FUTURE. On the Particle Identifier. Fushimi, K. 1973. (In Japanese).

From study meeting on radiation measuring instruments; Kumatori, Osaka, Japan (9 Dec 1972).

In proceedings of the study meeting on radiation measuring instruments.

Analogue computers are more simple and processing can be conducted faster as compared with digital computers, though accuracy does not come up to that of the latter. For example, when particle identification is performed according to the Goulding formula $T/a = (E + \Delta E)^{\alpha} - E^{\alpha} (\alpha = 1.73)$ in the case of S.S.D. particle identification with an E, ΔE counter telescope, the analogue particle identifier acting at high speed is needed in order to test with low yield particles in a very short time. This is explained referring to the particle identification spectrum obtained with the particle identifier designed for this purpose. The peaks corresponding to p,d,t, ^{3}He and α particles were separated comparatively well. This system can be applied to heavy ion identification, and approximation is easily obtained. Thus the behavior of the particle identifier can be spread to the domain of very small ΔE signals which cannot be done by the add-step method. The future problems are the improvement of the circuits and the development of a better logarithm converter. (JA)

33173 (KURRI-TR-115, pp 12-14) THE APPLICATION OF NEGATIVE TEMPERATURE STATE TO NUCLEAR DETECTORS. Itoh, H. 1973. (In Japanese).

From study meeting on radiation measuring instruments; Kumatori, Osaka, Japan (9 Dec 1972).

In proceedings of the study meeting on radiation measuring instruments.

In observing radiation, the primary effect of the radiation on matter such as the formation of ion pairs must be amplified by the order of 10^6 times by means of an electric field, chemical reaction or unstable condition of matter. A quite different method, i.e., the utilization of the negative temperature state of matter for amplification purposes, is described. The following three cases are considered: 1) application of the light occurring in the negative temperature state by the irradiation with a laser, for example a laser chamber; 2) usage of optical pumping for radiation detection, i.e., a quantum counter; and 3) the negative temperature state itself used as radiation-detecting element, i.e., a resonance counter. The possibility of radiation detection at extremely low temperature of positive state is also briefly discussed. (JA)

33174 (KURRI-TR-117, pp 11-15) EXPERIENCES OBTAINED IN MT. NOKOGIRIYAMA TUNNEL ON LOW LEVEL RADIATION MEASUREMENT. Tanaka, S. 1973. (In Japanese).

From study meeting on low-level radiation measurements; Kumatori, Osaka, Japan (22 Jan 1973).

In proceedings of the study meeting on low-level radiation measurements.

Since the method to avoid the background contribution of cosmic ray components, especially μ-mesons, by installing a measurement room underground brings excellent effects at low cost, the horizontal tunnel prepared by former Japanese army has been used, which is in the Mt. Nokogiriyama area, Futtsu, Chiba prefecture. There, temperature and power source voltages are in good stabilization. The NaI(Tl) crystal was ordered after selecting the material which contained the least ^{40}K and ^{208}Tl. The detector is shielded with a combination of oxygen-free copper, mercury, iron, and Lucite. Iron was, of course, selected under the condition that it did not contain ^{60}Co. Mercury was obtained by repeating careful evaporation and refinement procedures. Anti-coincidence shielding was also applied, using 20 cm thick iron and plastic scintillators. The results obtained in the measurement system indicate excellent shielding. They showed a significant shielding effect of the 20 cm thick iron room for the reduction of the cosmic ray components. (JA)

33175 (KURRI-TR-117, pp 20-65) SEVERAL EXAMPLES IN RECENT LOW LEVEL GAMMA MEASUREMENTS ABROAD. Sakamoto, K. 1973. (In Japanese).

From study meeting on low-level radiation measurements; Kumatori, Osaka, Japan (22 Jan 1973).

In proceedings of the study meeting on low-level radiation measurements.

For convenience of aiding the new design or improvement of low level radiation measuring devices, the ample recent results abroad in that field are introduced. Some expression for the figure of merit has been proposed on the factors affecting minimum detectable activity. For example Phelp and others defined S/N (PF) as follows, which is the quantity indicating γ peak presence or detectability. $S/N(PF) = (\text{efficiency})/(\text{resolution})\,(\text{background})^{\frac{1}{2}}$. The means to reduce background requires acquisition of shielding materials with far less impurities. Low level measuring systems are divided into the following five categories: 1) NaI (Tl (M)-plastic scintillator(G); 2) NaI(Tl) (M)-NaI(Tl) (G); 3) Ge (Li) (M)-plastic scintillator (G); 4) Ge(Li) (M)-NaI(Tl) (G); and 5) others. Designation (M) means main detector, and (G), guard in anti-coincidence mode. The paper is a survey on world-wide low level γ measurements. (JA)

33176 (KURRI-TR-117, pp 69-71) LOW LEVEL BETA MEASUREMENT WITH PROPORTIONAL COUNTER. Kigoshi, K. 1973. (In Japanese).

From study meeting on low-level radiation measurements; Kumatori, Osaka, Japan (22 Jan 1973).

In proceedings of the study meeting on low-level radiation measurements.

A few problems on the technique to accurately measure the specific activity of gaseous low level emitters are described. The determination of specific activity requires the measurement of both volume and activity of samples. The gaseous samples have the advantage that their volume can be measured simply and accurately. However temperature variation must be paid attention because of the slow follow-up of counters. Radioactivity measurement includes two methods. One is to measure under the same conditions by keeping the gas pressure constant, and another is to measure while the gas pressure is not kept necessarily constant corresponding to the sample volume. In both cases, precautions to gas pressure cannot be neglected, because it affects error due to the non-zero plateau gradient of proportional counters. In anti-coincidence counting, the plateau gradient can simply be made zero. The error in a mixing ratio measurement and that in a mixing imperfection must be taken into consideration if the measurement is carried out by mixing the gas of known specific activity to obtain the proper counter pressure or to make the pressure constant. (JA)

33177 (KURRI-TR-117, pp 100-104) PROGRAM FOR THE FACILITIES FOR THE STUDY ON LOW LEVEL RADIATION MEASUREMENT IN KANAZAWA UNIVERSITY. Sakanoue, M. 1973. (In Japanese).

From study meeting on low-level radiation measurements; Kumatori, Osaka, Japan (22 Jan 1973).

In proceedings of the study meeting on low-level radiation measurements.

Low level activity measuring facilities are reported, which are a part of the establishment program of the "Environmental Radioactivity Experiment Center" as the facilities for common utiliza-

tion. The reason for the establishment is three-fold: indispensability of the detection of low level radiation and its determination in environmental activity investigation; necessity for preparing the measuring system with low background, high counting efficiency, and excellent resolution; and availability of standard calibration of instruments. An outline of the facilities and equipment is given. The measuring rooms are arranged in accordance with the type and level of sample activity. Highly sensitive measuring apparatuses are installed systematically and functionally. An underground facility is prepared to avoid the cosmic ray contribution. A power source stabilizer, noise elimination system and air conditioner are installed as underground ancillary equipments. Closely examined Hg, Fe, Cu and Pb are used for shielding. In these facilities, research and development of new instruments and measuring methods, plans for new facilities, data processing techniques, and sample preparation techniques will be practiced under the cooperation of common utilization investigators and the basic study section in this center. (JA)

33178 (KURRI-TR-117, pp 105-108) PLAN OF THE LABORATORY HAVING LOW BACKGROUND SPACE IN NATIONAL INSTITUTE OF RADIOLOGICAL SCIENCES. Abe, S. 1973. (In Japanese).

From study meeting on low-level radiation measurements; Kumatori, Osaka, Japan (22 Jan 1973).

In proceedings of the study meeting on low-level radiation measurements.

For low level activity measurement, the realization of low background has been generally emphasized. However, it is not sufficient, and good scattering characteristics are needed when an experiment is carried out with radiation sources. In this plan of a laboratory, these two points were taken into consideration. The wall material and shape as well as room dimensions must be considered to improve and reduce scattering. Extreme effort should be made so that special peaks do not appear in energy spectra. The target values of radiation level in the room are below 0.1 μR/h for cosmic ray, below 0.05 μR/h for γ contribution from the earth and structural material, and below 1×10^{-11} Ci/cm^3 air for radon and thoron concentration in the room atmosphere. The laboratory is composed of three parts: a low background space room of 20 m underground, a low background measurement room of 3 m underground, and a low background building on the ground. Many experiments are scheduled in this laboratory. (JA)

33179 INITIAL CLINICAL EXPERIENCES WITH A FRESNEL ZONE-PLATE IMAGER. Farmelant, M. H.; DeMeester, G.; Wilson, D.; Barrett, H. (Univ. of Massachusetts, Amherst). J. Nucl. Med.; 16: No. 3, 183-187(Mar 1975).

First clinical studies with a Fresnel zone-plate radioisotope imager demonstrate high resolution, sharp tomography, and freedom from scatter. Improved radionuclide imaging is demonstrated, at least for small organs like the thyroid. Certain limitations are present that indicate a need for additional development before application to routine clinical practice. (auth)

33180 RADIATION DETECTORS MADE FROM INTRINSIC GERMANIUM. Colante, D.; Gislon, R. (CNEN, Milan). Elettrotecnica; 61: No. 1, 1-5(1974). (In Italian).

The problems connected with the detection of gamma and x radiation by means of the newly introduced intrinsic germanium detectors are reviewed on the basis of the results that have begun to appear in the technical literature. (auth)

33181 COMPARISON OF INTEGRAL AND DIFFERENTIAL METHODS OF LOW LEVEL GAMMA ACTIVITY MEASUREMENTS. Chudy, M. (Komenskeho Univerzita, Bratislava (Czechoslovakia). Prirodovedecka Fakulta). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; No. 13, 203-215(1973). (In Slovak).

Differential and integral methods of low-level gamma activity measurements of various radioisotopes are discussed. (auth)

33182 APPLICATION OF THE "NEUTROSTOP" SHAPED BRICK IN LOW LEVEL COUNTING. Chrapan, J.; Sitar, B. (Komenskeho Univerzita, Bratislava (Czechoslovakia). Prirodovedecka Fakulta). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; No. 13, 195-202(1973). (In Slovak).

The feasibility is discussed of applying polyethylene and boric acid in "neutrostop" shaped bricks used as a shielding layer in low-level counting. Also discussed are the properties of shields made from Cd, Fe, Pd, neutrostop layers, and of a vacuum shield. (auth)

33183 PROTOTYPE PRODUCTION OF THE WHOLE BODY SCANNER. Oyamada, H.; Kawachi, K.; Ishibashi, H. (National Cancer Center, Tokyo (Japan)); Nakanishi, S.; Toda, M. Radioisotopes (Tokyo); 23: No. 9, 516-522(Sep 1974). (In Japanese).

There are two probes, having crystals 5 inches in diameter, which are opposed vertically. The spacing is provided for 1.5, 3.0, 4.5, 7.5, 9.0, 15.0, and 30.0 mm. The scan speed can be changed from 20 cm/min to 500 cm/min. The image ratio is provided for 1/5, 1/3, 1/1. The recording system is composed of two channels, each of which has both dot and photo recording systems. In the photo recording box, there are various slits of different sizes. The newly designed devices are 1) program scanning attachment, 2) simultaneous recording system of profile scan pattern during the scintiscanning, and 3) output system for computer processing. (WHK)

33184 NEUTRON THERMOPILES AND GAMMA-THERMOMETERS. Chapter 9. Shimanskaya, N. S. pp 261-279 of Ionizing Radiation Calorimetry. Moscow, Atomizdat (1973). (In Russian).

This chapter of the monograph considers the basic characteristics of neutron batteries (sets of plates) and design estimates. Neutron sets of plates with a boron or uranium covering are used for measuring thermal neutron fluxes, and are widely used in control systems and the shielding of nuclear reactors. Consideration is also devoted to construction features and the use of gamma thermometers, in particular, for controlling the evolution of heat in fuel rods. A presentation is given of the properties of a series of materials suitable for preparing the needles of gamma-thermometers. (tr-SJR)

33185 RADIATION INDICATOR. Hajek, J. Sdelovaci Tech.; 22: No. 5, 185-187(May 1974). (In Czech).

The design and function are clarified of a simple radiation indicator equipped with improved stabilization of the high voltage source attained by means of a silicon diode in the impermeable direction. The MAA 125 integrated circuit is applied as pulse amplifier. (auth)

33186 SOME CHARACTERISTICS OF CORONA COUNTERS. Oravec, J. Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; No. 13, 167-194(1973). (In Russian).

The results are summed up of measuring volt-ampere characteristics, operating characteristics, gas amplification, and the amplitude ratio of alpha-particle pulses to corona current pulses, for corona counters with various gas fillings (argon, neon, methane, and nitrogen) in dependence on pressure and loading resistance. (INIS)

33187 GAS FILLING OF CORONA COUNTERS (MIXTURE OF GASES). Oravec, J.; Benovic, D. Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; No. 14, 105-111(Dec 1973). (In Slovak).

Main characteristics of corona counters filled with a mixture of gases were studied on a counter filled with double and triple mixtures of argon, neon, and methane. The volt-ampere characteristic, gaseous amplification, the A_α/A_k ratio and operating characteristics were measured. (auth)

33188 SOME PROPERTIES OF A PROPORTIONAL COUNTER FOR LOW LEVEL ^{3}H AND ^{14}C COUNTING. Szarka, J.; Usacev, S.; Povinec, P. (Komenskeho Univerzita, Bratislava (Czechoslovakia). Prirodovedecka Fakulta). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; No. 13, 117-129(1973). (In Slovak).

Experimental equipment is described for low-level counting of ^{3}H and ^{14}C. The applicability of a proportional counter in the measurement is discussed. Operating parameters of counters with methane or ethane fillings were studied for various input sensitivities of the electronic equipment, for various gas filling pressures, hydrogen admixtures in methane, etc. Horizontal and vertical shifts of the plateau related to the input sensitivity and the gas filling pressure were investigated. (INIS)

33189 LARGE-VOLUME MULTIWIRE CORONA COUNTER. Usacev, S.; Oravec, J.; Holy, K. Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; No. 14, 113-126(Dec 1973). (In Slovak).

A description is given of a large multiwire corona counter as well as of the filling, purification, and counting systems. Parameters of the counter important for measuring low-level alpha activity are discussed. (auth)

33190 STUDY OF EMF OCCURRING ON IRRADIATING PHOTOTUBE ELEMENTS WITH ALPHA PARTICLES. Lobanov, E. M.; Starodubtsev, S. V. pp 323-338 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

A photoelement and an alpha-particle source were mounted in a cylindrical chamber 180 mm in diameter filled with air or other gas. The working surface of the photoelement irradiated by alpha particles was 14 mm. The energy of the alpha particles could be varied by changing the gas pressure in the chamber. The polonium alpha particles had an average range of 38.05 mm in air. The primary current in the photoelement (selenium) semiconductor and the emf were measured electrically. The measured

current was proportional to the alpha-particle flux, and can be used as a simple reliable means of measuring the charged particle flux. The current from the photoelement decreases somewhat with increasing radiation dose. The effective thickness of the sensitive layer of the photoelement was estimated by varying the energy of the alpha particles. (SJR)

33191 FIGURE OF MERIT TO DEFINE GAMMA CAMERA PERFORMANCE. Ben-Porath, M. (Haifa Inst. of Tech., Israel). pp 382-388 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

The characteristics of a gamma camera system should be defined by a set of interacting, measurable parameters, which truly determine its performance. These parameters, properly combined, define an overall figure of merit which expresses the performance of the gamma camera. The suggested parameters are: intrinsic resolution as defined by full width at half maximum (FWHM), the detector area over which this value is homogeneous, the detector area over which the efficiency is homogeneous, the system dead time and the ratio of usable counts under the photopeak to the integral count, which is a function of the system energy resolution. All these parameters are easily measurable and should be reproduceable. Based on the above parameters, an overall figure of merit has been derived. This paper discusses the derivation of this figure of merit and illustrated its usefulness. (auth)

33192 CHARACTERISTICS AND OPERATION OF A COMPUTER-CONTROLLED SCANNING SYSTEM. Guzzardi, R.; Mey, M.; Bianchi, R. (Univ. of Pisa, Italy). pp 418-427 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In French)

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

The construction and operation of a versatile scanning system is described. Its main feature is the possibility of a constant computerized control of all its operations. The system has a total of 11 degrees of freedom, 6 detectors, controls for the driving motors and a counting unit for the registration of gamma events. It is linked by an interface to a 16 K memory. It is also linked to several peripherals, such as a teletype, a magnetic tape unit, a storage oscilloscope, a rapid printer, and an incremental plotter for the registration and evaluation of experimental data. The necessary soft ware for the control of the movement of the detector, the registration and storage of gamma events, the control of the speed of the driving motors, the correction for scalloping, and (as novelty of this system) the correction for radioactive decay during the examination are described. The latter is very important for radioisotopes with short half-life and opens new possibilities in scintigraphy. In addition, the iterative procedure used to process a matrix of data by computer, in order to emphasize particular aspects or suppress background noise around regions of interest, and subsequently to display it in grey-scale or as numerical map, is described. Some results obtained with the system are presented. (auth)

33193 NEW TECHNIQUES OF HARD COPY PRODUCTION FROM THE GAMMA CAMERA. Kitching, R. C.; Bentley, R. E.; McCready, V. R. (Royal Marsden Hospital, Sutton, Eng.). pp 434-439 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

A small digital computer-based system has been developed to produce a variety of types of hard copy from the Anger camera. The object of the study is to integrate the speed of the gamma camera with the best features of typical rectilinear scanner displays, yet using a cheap output format. Special attention has been paid to the mode of operation so that the simplicity of use of the gamma camera is retained. A keyboard and oscilloscope have been added to the camera console. Specific programs for each organ on test have been written, and these are called down by touching a key. Patient data is then entered once and this is followed by a long-persistence image to facilitate positioning. When a preset time or count has been reached, a variety of suitable sized images are produced on an oscilloscope, color television, or electrostatic printer with a number of grey or color levels. Automatically uniformity-corrected and smoothed images are printed out twice, to permit one copy to be placed in the patient's record. The value of the processing is discussed in relation to the clinical results obtained during the first six months of operation. (auth)

33194 NEW MINIATURE SCINTILLATION COUNTER FOR REGIONAL BLOOD FLOW MEASUREMENT IN SMALL TISSUE VOLUME. Jordan, K. (Medizinische Hochschule, Hanover); Brock, M.; Knoop, B.; Weber, R.; Nentwig, C.; Herbst, I.; Dietz, H. pp 514-518 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Measurements of regional blood flow in small volumes have been successfully carried out using a silicon semi-conductor. An arrangement of several such detectors permits measurements in very small areas which would otherwise be inaccessible in view of the small space available. The disadvantages are low sensitivity, high background noise, and poor energy resolution. A scintillation probe using a small NaI(Tl) crystal (3 mm diameter) was optically coupled via a flexible lightpipe with the photocathode of a photomultiplier. This system has the advantage of the semiconductor system without its disadvantages. Measurements of brain blood flow in a small animal demonstrate the performance of the system. (auth)

33195 COMPARISON OF SOME CHARACTERISTICS OF NAI (Tl) CRYSTALS AS A FUNCTION OF THEIR DIMENSIONS. Charrier, J. (Laboratoire Central des Ponts et Chaussees, 75 - Paris (France)). Nucl. Instrum. Methods; 123: No. 3, 477-488(1 Feb 1975). (In French).

The choice of the detector is of prime importance for the development and operation of radioisotope apparatus used in civil engineering. The two principal characteristics of the scintillation crystal-photomultiplier tube assembly for gamma ray activity detection, i.e., the photoelectric efficiency and the total efficiency for several specific detection geometries, is discussed. These two efficiencies are compared for NaI(Tl) crystals of different sizes. (auth)

33196 SOLID-ANGLE AND SELF-ABSORPTION FACTORS FOR AN INCLINED CYLINDRICAL SOURCE VIEWED BY A CYLINDRICAL DETECTOR. Horowitz, Y. S.; Mordechai, S.; Dubi, A. (Ben-Gurion Univ. of the Negev, Beersheba (Israel)). Nucl. Instrum. Methods; 123: No. 3, 551-555(1 Feb 1975).

A Monte Carlo method is presented for the calculation of the self absorption of γ radiation in an inclined cylindrical source and for the calculation of the solid angle of the source subtended by a cylindrical detector. The source is centered on the symmetry axis of the detector and can be rotated through an angle from 0^0 to 90^0 around an axis perpendicular to the detector axis. Typical corrections to angular correlation measurements in multi-detector goniometers are presented and discussed. (auth)

33197 CANISTER CRYOGENIC SYSTEM FOR COOLING GERMANIUM SEMICONDUCTOR DETECTORS IN BOREHOLE AND MARINE PROBES. Boynton, G. R. (U. S. Geological Survey, Reston, Virginia, USA, 22092). Nucl. Instrum. Methods; 123: No. 3, 599-603(1 Feb 1975).

High resolution intrinsic and lithium-drifted germanium gamma-ray detectors operate at about 77 to 90 K. A cryostat for borehole and marine applications has been designed that makes use of prefrozen propane canisters. Uses of such canisters simplifies cryostat construction, and the rapid exchange of canisters greatly reduces the time required to restore the detector to full holding-time capability and enhances the safety of a field operation where high-intensity ^{252}Cf or other isotopic sources are used. A holding time of 6 h at 86 K was achieved in the laboratory in a simulated borehole probe in which a canister 3.7 cm diameter by 57 cm long was used. Longer holding times can be achieved by larger volume canisters in marine probes. (auth)

33198 ACCURATE AMPLITUDE MEASUREMENT AND TIME PICK-OFF METHOD FOR THE BROAD PULSE WIDTH RANGE OF NUCLEAR DETECTORS. Lakatos, T.; Mathe, Gy. (Institute of Nuclear Research of the Hungarian Academy of Sciences, H-4001, Debrecen, Hungary). Nucl. Instrum. Methods; 123: No. 3, 579-582(1 Feb 1975).

Using semiconductor detectors, the optimum shaping time constant varies between 0.1 to 50 μs which leads to a pulse width change of more than two orders of magnitude. In such a wide range, both single- and multichannel analysers can measure amplitudes only at the expense of a loss in the speed of a measurement, in energy resolution or accuracy. The device presented here produces square-wave analog pulses by means of a sampling technique. Square-wave pulses are ideal both for single- and multichannel amplitude analysers. The choice of the optimum sampling time follows automatically and the time pick-off characteristics are good. There is no additional dead time. (auth)

33199 AN EMPIRICAL FUNCTION WHICH RELATES THE SLOPE OF THE Ge(Li) EFFICIENCY CURVES AND THE ACTIVE VOLUME. Vano, E.; Gonzalez, L.; Gaeta, R.; Gonzalez, J. A. (Junta de Energia Nuclear, Madrid (Spain). Div. de Fisica). Nucl. Instrum. Methods; 123: No. 3, 573-574(1 Feb 1975).

By using experimental data from some Ge(Li) detectors, an empirical function which relates the slope of the efficiency curves to the active volumes has been adjusted. With this function, the efficiency decrease with energy increase can be predicted for each particular detector within an error less than 3%. (auth)

33200 SATELLITE-BORNE SILICON SEMICONDUCTOR DETECTOR TELESCOPES FOR OBSERVATION OF RELATIVISTIC HEAVY PRIMARY COSMIC RAYS. Yoshimori, M.; Murakami, H.; Tsukuda, M.; Nakagawa, S. (Rikkyo Univ., Tokyo (Japan). Dept. of Physics). Nucl. Instrum. Methods; 123: No. 3, 609-614(1 Feb 1975).

It is considered that the observation of the chemical composition of relativistic heavy primary cosmic rays yields important information on the origin and propagation mechanism of cosmic rays. Satellite-borne silicon semiconductor detector telescopes composed of six identical surface-barrier type detectors were made to observe the charge spectrum of relativistic heavy primary cosmic rays from carbon to nickel with a high accuracy. The minimum pulse selection method is applied to detector telescopes in order to increase the resolving power of identification of the nuclear charge of relativistic heavy primary cosmic ray nuclei. The charge resolution of relativistic heavy primary cosmic rays estimated based on the minimum pulse selection method is shown and compared with one of the other cosmic ray detectors. The silicon semiconductor telescope, detection and electronics system and data processing are described in detail. The instrument will be put aboard the Japanese cosmic radiation satellite CORSA scheduled for launch in February 1976. (auth)

33201 PERFORMANCE OF Ge(Li) DETECTORS AT VARIOUS TEMPERATURES AND STRONG MAGNETIC FIELDS. Kuegele, B. A.; Weber, H. W. (Atominstitut der Oesterreichischen Hochschulen, Vienna). Nucl. Instrum. Methods; 123: No. 2, 285-288(15 Jan 1975).

Pulse rise time and energy resolution of a planar Ge(Li) detector were investigated in the temperature range from 77 to 200 K and in transverse magnetic fields up to 4 T. For temperatures below ~150 K the experimental results confirm the decreasing influence of magnetic fields on the spectrometer properties predicted by calculations of the drift mobilities in strong magnetic fields. Above this temperature a continuous increase of pulse rise times is observed, whereas the energy resolution deteriorates abruptly at ~160 K and improves again at higher temperatures. The optimum performance in strong magnetic fields is obtained at 140 K. (auth)

33202 A NEW APPROACH TO SEMICONDUCTOR DETECTOR EFFICIENCY CALIBRATION. Abreu, M. C.; Maio, A. A.; D'Oliveira, M. J. T. (Laboratory of Physics, University of Lisbon, Portugal). Nucl. Instrum. Methods; 123: No. 2, 295-300 (15 Jan 1975).

The efficiency calibration of a coaxial Ge(Li) detector was established experimentally and fitted to a semi-empirical function based on Mowatt's formula. The good agreement obtained in the relative efficiency curve (2 to 3%) within the energy range 50 to 1300 keV shows that a development of Mowatt's formula is possible for coaxial devices. The same function, with some simplifications, was fitted to the experimental efficiencies measured for a planar Si(Li) detector in the energy range 8 to 60 keV. For the Ge(Li) detector the IAEA set of calibrated sources was used for absolute efficiency determinations and another set (^{75}Se, ^{133}Ba, ^{228}Ra, ^{56}Co) for the relative efficiency measurements. Both the IAEA set and a new one named "Variable energy X-ray sources" which provide a fixed geometry, were used for the Si(Li) detector measurements. The semiempirical fit used enables the determination of the physical parameters of each detector which are then compared with the values predicted by Paradellis and Hontzeas. (auth)

33203 TIMING PROPERTIES OF THIN SCINTILLATOR FOILS. Batsch, T.; Moszynski, M. (Institute of Nuclear Research, Warsaw (Poland)). Nucl. Instrum. Methods; 123: No. 2, 314-352(15 Jan 1975).

The scintillation efficiency of two different thin film detector designs was compared. The better design was chosen to perform studies on scintillation efficiency, light pulse shape and time resolution of NE 111 and NE 102A scintillator foils. The influence of the surface quenching effect on the scintillation efficiency was observed. Interesting phenomena such as the decay time constant and the pulse width decrease for very thin scintillator foils were measured. The dependence of the time resolution of thin scintillator foils on their thickness and the mean number of photoelectrons released on a photocathode by a light flash were examined. On the basis of the modified Hyman theory of timing with scintillator counters it was concluded that in the case of very thin scintillator foils made of ternary-solution plastic scintillator, the role of the second scintillating species in the energy transfer process is strongly limited. (auth)

33204 THE USE OF LARGE AREA SCINTILLATION DETECTORS FOR SIMULTANEOUS DETERMINATION OF CHARGE AND POSITION OF IONIZING PARTICLES. Schmidt, W. K. H.; Simon, M. (Max-Planck-Institut fuer Physik und Astrophysik, Garching; Muenchen (F. R. Germany). Inst. fuer Extraterrestrische Physik). Nucl. Instrum. Methods; 123: No. 2, 333-339 (15 Jan 1975).

Two 1 m^2 scintillator-light-pipe-phototube configurations have been employed to determine the position of incidence of ionizing particles. For this, the nonuniformity of light collection by the phototubes has been used, and the spatial and pulse height resolution investigated. The experimental approach is described and the results are discussed. Both versions provide a spatial resolution of several centimeters for a relativistic singly charged particle. A resolution of less than ± 1 cm is achievable for carbon nuclei or heavier particles in cosmic rays adequate for some applications. These scintillator systems are extremely useful for cosmic ray composition measurements because they allow large areas and the determination of charge and trajectory with one detector system. The advantage over gas counters is that the position measurements are virtually insensitive to delta electrons accompanying the heavy particles, or to backscattered particles. These detectors are also useful for singly charged particles where only moderate spatial resolution is required. (auth)

33205 A SIMPLE METHOD TO DETERMINE THE RESOLVING TIME OF A NaI(Tl) SCINTILLATION DETECTOR. Mudhole, T. S.; Umakantha, N. (Karnatak Univ., Dharwar (India). Dept. of Physics). Nucl. Instrum. Methods; 123: No. 2, 405-407(15 Jan 1975).

A simple method is described to determine the resolving time of a NaI(Tl) scintillation detector by recording the photopeak and the random sum peak due to monoenergetic gamma rays from a ^{137}Cs source. (auth)

33206 AFTER-PULSE SUPPRESSION FOR 8850 AND 8854 PHOTOMULTIPLIERS. Lamaze, G. P.; Whittaker, J. K.; Schrack, R. A.; Wasson, O. A. (National Bureau of Standards, Washington, D. C. (USA). Center for Radiation Research). Nucl. Instrum. Methods; 123: No. 2, 403-404(15 Jan 1975).

After-pulsing suppression of semi-conducting first dynode photomultipliers (RCA 8850 series) has been successfully accomplished by applying a positive pulse to a wire mesh directly in contact with the tube face. (auth)

33207 PLANAR CHANNELING AND BLOCKING EFFECTS IN SCINTILLATION RESPONSE OF ANTHRACENE SINGLE CRYSTALS BOMBARDED BY α-PARTICLES OF ENERGIES 6.05 AND 8.78 MeV. Rosendahl, E. W. (Goettingen Univ. (F. R. Germany). 2. Physikalisches Inst.). Z. Phys.; 270: No. 4, 377-381(Nov 1974). (In German).

The scintillation response of anthracene single crystals to α-particles of the energies 6.05 and 8.78 MeV has been investigated as a function of angle of incidence. When the α-particles were incident to the (100) plane, the well-known local minimum of scintillation response occurred. More than that, a detailed investigation showed a small maximum of scintillation response within the minimum. The widths and the relative height or depth, respectively, were calculated by the theory of planar channeling and blocking of the α-particles. (auth)

33208 STATISTICAL PROPERTIES OF GAUSSIAN-LORENTZIAN LIGHT AND DEAD TIME LOSS OF PHOTON-COUNTING SYSTEM. Kikkawa, A.; Ohkubo, K.; Yoshimura, T.; Suzuki, N. (Osaka Univ., Suita (Japan). Faculty of Engineering). Jap. J. Appl. Phys.; 13: No. 8, 1226-1231(Aug 1974).

The counting loss of a circuit with a dead time is increased according to the input counting rate and the dead time as well as the parameters of the statistical distribution of input pulsed in photocounting of the Gaussian-Lorentzian light. Relationship between the spectral linewidth of the incident light and the counting loss is investigated theoretically and experimentally, when a single channel dead time system is used. Moreover, a multichannelized dead time system is employed by using a scaling technique. It is recognized that the spectral linewidth can be determined from measurement of the counting loss. (auth)

33209 DEVELOPMENT OF 1024 CHANNEL PULSE HEIGHT ANALYZER SYSTEM FOR BALLOON APPLICATION. Murakami, H.; Tsukuda, M. (Rikkyo Univ., Tokyo (Japan). Faculty

of Science). Tokyo Daigaku Uchu Koku Kenkyusho Hokoku; 10: No. 1, pt. B, 210-217(Mar 1974). (In Japanese).

A balloon-borne 1024 channel pulse height analyzer has been developed for observing galactic γ-rays, which can measure γ-rays at an energy resolution of approximately 5 keV over the wide range of energy with a Ge(Li) detector. Most pulse height analyzers borne on balloons have the system to perform only AD conversion and data transmission, while data processing and memory systems are set on the ground. The analyzer employs the above described system. Integral non-linearity is within ±0.1% in case of more than 150 channels if computed by assuming a reference line from measured results. Differential non-linearity is better than ±3% in case of more than 150 channels. Since counting-loss is nearly nil below 100 cps and approximately 32% at 500 cps, true counting rate can be determined with the accuracy of a few % error by correction. A temperature effect, the base-line drift of approximately 0.1 channel/°C was found in the range from +20 to −30°C, but the change of AD conversion gain seems to be nearly zero. (JA)

33210 SEMICONDUCTOR DETECTOR. Takayanagi, S.; Sugita, T.; Kobayashi, T. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1973-18876/B/, 17 Feb 1969. 5p. (In Japanese).

The present invention relates to a semiconductor radiation detector which makes absolute measurement of the β-ray intensity of ^{85}Kr inside a bronchial tube. ^{85}Kr is injected into the human body and the ventilation capacity of the lung is determined by detecting the ^{85}Kr exhaled into the bronchial tube from the lung. (WHK)

33211 AN ELECTRIC FIELD DISTORTION IN A PARALLEL PLATE FREE AIR CHAMBER. Sakihara, K. (Electrotechnical Lab., Tanashi, Tokyo (Japan). Tanashi Branch). Denshi Gijutsu Sogo Kenkyusho Iho; 38: No. 6-7, 325-333(Aug 1974). (In Japanese).

A method has been developed to correct the error due to distortion of the electric field in a parallel plate free air ionization chamber. There are various factors which cause the distortions: the lack of coplanability in the electrode system, effect of the shielding vessel, disorder of potential in the guard electrodes, potential difference between the collector and guard plates, space charge effect, and so on. The distortion factors for the electric field are usually measured by an analogy method. By this method, however, the correction is made only for the distortion due to the effect of the shielding box but not for the one due to the other factors. Therefore the distortion due to each cause is separately examined in detail and applicability of the analogy method to the chamber is discussed. It has been concluded that the analogy method is not suitable for the accurate measurement of the correction coefficient. By a newly developed method, the ionization volume is measured by scanning the whole space among the collector and the high tension electrode with a slit beam of low energy x-rays. From a curve of ionization current vs. x-ray beam position, it is possible by extrapolation to obtain the amount of the field distortion which comes from all the factors except the space charge. The method has been applied to the standard chamber for low energy x-rays at the Electrotechnical Laboratory, and the optimum condition of geometry to minimize the field distortion has been examined. (auth)

33212 AN ACCURATE FORMULA FOR TWO-SOURCE METHOD OF MEASURING GEIGER COUNTER RESOLVING TIME. Hara, K.; Kanno, K. (Tokai Univ., Tokyo (Japan)); Akutsu, J. Rikagaku Kenkyusho Hokoku; 50: No. 5, 180-189 (Sep 1974). (In Japanese).

When the difference between both counting rates obtained from two sources is within 20%, a simple expression for determining the values of resolving time with accuracy below 1% can be derived mathematically. The accuracy of this expression is also discussed in comparison with approximate formulas proposed by many authors. The experimental conditions and the standard deviation of the resolving time in practical use of the formula are described. (auth)

Radiation Dosimeters

Refer also to abstracts 33359, 34148, and 35043.

33213 (AD/A-000953) PERFORMANCE OF AN IMPROVED METHANE-FLOW PROPORTIONAL COUNTER FOR TSEE. Ritz, V. H.; Attix, F. H. (Naval Research Lab., Washington, D. C. (USA)). 23 Oct 1974. Contract AT(49-7)-1864. 17p. (NRL-7807). NTIS $3.25.

An improved methane-flow proportional counter for detecting thermally stimulated exoelectron emission (TSEE), which permits simultaneous measurements of thermoluminescence and TSEE on a single sample, has been developed. The proportional counter is described, and influences on the day-to-day stability and reproducibility of the counter and associated equipment are discussed. (GRA)

33214 (AED-CONF-74-509-001) SOME ADVANCES IN SOLID-STATE FAST NEUTRON DOSIMETRY. Becker, K. (Oak Ridge National Lab., Tenn. (USA)). 1974. 7p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974). With abstract.

Progress which has been made at Oak Ridge National Laboratory in solid-state fast neutron dosimetry since the last review on this subject was presented in 1972 is summarized with emphasis on the following topics: 1) further studies on the directional and energy response characteristics of TSEE detectors based on ceramic BeO covered with hydrogenous radiators, and on a new method for extending the dynamic range of gas-flow TSEE readers by two orders of magnitude; 2) experiments with highly dispersed and sensitive TLD phosphors permanently embedded in high-melting organic radiators such as p-sexiphenyl; 3) investigations on the automatic spark counting of neutron-induced recoil particle tracks in thin polymer foils after extended etching; and 4) studies concerning the feasibility of intercomparisons by mail of neutron sources with an accuracy of better than ± 5% in the approximately 50 to 500 rad range by using fission fragment track etching. The relative merits and disadvantages of the various methods, for personnel monitoring and other applications are discussed briefly and a few other promising approaches are mentioned. (auth)

33215 (AED-CONF-74-509-014) DEVELOPMENTS IN THE USE OF IONIZATION CHAMBERS FOR MIXED FIELD DOSIMETRY. Sherwin, A. G. (National Radiological Protection Board, Harwell (UK)). 1974. 9p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974). With abstract.

A method for the separate estimation of the absorbed dose components of a mixed field of neutrons and gamma radiation is described. The method relies on the application of statistical analysis to the fluctuating ionization current. The theoretical basis for the method is developed and the results of experimental studies designed to test the theory are presented. The main advantage of the method of stochastic current analysis is that it can be used to estimate the dose components satisfactorily in mixed fields in which only a small fraction of the total absorbed dose is due to neutrons. (auth)

33216 (AED-CONF-74-509-024) NEUTRON DOSIMETRY IN BIOLOGY AND MEDICINE. Bewley, D. K. (Hammersmith Hospital, London (UK). M. R. C. Cyclotron Unit). 1974. 11p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974). With abstract. Available from ZAED.

Instruments for neutron dosimetry can be classified in various ways. The most accurate primary instrument for measuring the total dose in a neutron field is the tissue-equivalent calorimeter. The complexity of the apparatus and the time needed for thermal equilibration limit its use to standardization of other instruments. The tissue-equivalent ionization chamber is a more convenient method of measuring the total dose, with almost as good an accuracy. The principal sources of uncertainty are the ratio of W values for neutrons compared to photons or electrons, and the ratio of stopping power between solid and vapor of the same chemical composition. Recent experimental information on these questions is surveyed. To derive the partial dose of neutrons alone, a neutron insensitive dosimeter is needed. The neutron sensitivity of these usually rises with neutron energy; specially designed Geiger counters and photographic film seem the best, particularly at higher neutron energies. Activation methods, proportional and scintillation counters also give information about radiation quality, besides discriminating against γ radiation. (auth)

33217 (INIS-mf-1597, pp 218-235) PROGRESS IN THE DOSIMETRIC APPLICATIONS OF EXOELECTRON EMISSION. Becker, K. Feb 1974.

From 4th international symposium on exoelectron emission and dosimetry; Liblice, Czechoslovakia (25 Sep 1973).

In 4th international symposium on exoelectron emission and dosimetry.

Exoelectron phenomena are used currently as a research tool in solid-state physics, to detect structural damage in metals, and in radiation dosimetry. Progress in this latter field during the last three years is reviewed briefly. It includes some work on optical stimulation, but mostly on thermal stimulation techniques. The search for new material has centered around metal oxides (BeO, Al_2O_3, with and without "activators") and mixtures of oxides in-

cluding ZnO, SiO_2, TiO_2 and BaO. Closed GM-tube TSEE detectors have been developed, but bare discs of ceramic BeO:Si continue to be the most popular material. In the instrumentation field, the counter characteristics are now better understood, and improved counters have been designed. Ionization chambers have been employed successfully in high dose level readers. Among the various applications of TSEE dosimeters, interface dosimetry, measurement of low-energy (tritium) beta radiation, and fast neutron dosimetry via recoil proton registrations were most notable. Some recent data from ORNL on the directional and energy response of fast neutron TSEE dosimeters are given. Although unsolved problems still persist in preparing and reading out on a routine basis large quantities of detectors, their high radiation sensitivity in a very small sensitive volume offers unique advantages in several areas of radiation research. The general outlook for exoelectron dosimetry is cautiously optimistic. (auth)

33218 (INIS-mf-1597, pp 236-240) APPLICATION OF Li_2O TREATED BeO CERAMICS FOR THE DETECTION OF FAST NEUTRONS IN MIXED RADIATION FIELDS. Kriegseis, W.; Scharmann, A. Feb 1974.

From 4th international symposium on exoelectron emission and dosimetry; Liblice, Czechoslovakia (25 Sep 1973).

In 4th international symposium on exoelectron emission and dosimetry.

The method of detecting fast neutrons in mixed radiation fields is tested using ceramic discs of 99.25% BeO (Beryllco FD 5) on which Li_2O was pressed (1.5×10^8 N cm^{-2}). The results of response measurements are presented. (ZS)

33219 (INIS-mf-1597, pp 241-243) ABOUT THE ENERGY DEPENDENCE OF THE EXOELECTRON EMISSION OF BERYLLIUM OXIDE IRRADIATED BY PHOTONS. Kriks, H. J.; Siegel, V. Feb 1974.

From 4th international symposium on exoelectron emission and dosimetry; Liblice, Czechoslovakia (25 Sep 1973).

In 4th international symposium on exoelectron emission and dosimetry.

Exoelectron emission from BeO can be stated to be proportional to the dose in the surrounding material. Energy dependence of the exoelectron dosemeter is only found in case this material is different from the one the absorbed dose is meant for. Then, the mass energy transfer coefficients η/ρ of the two materials are to be taken into account, which generally depend in various ways on the photon energy. This relation was investigated experimentally in the photon energy range from 20 keV up to 1.25 MeV for 4 different surrounding materials with lower and higher atomic numbers Z as compared to air. (auth)

33220 (INIS-mf-1597, pp 244-246) THE DETERMINATION OF ACTIVATION ENERGIES FROM ISOTHERMAL FADING IN BeO EXOELECTRON DOSIMETERS. Kriks, H. J. Feb 1974.

From 4th international symposium on exoelectron emission and dosimetry; Liblice, Czechoslovakia (25 Sep 1973).

In 4th international symposium on exoelectron emission and dosimetry.

In applying the exoelectron effect for dosimetric purposes, fading plays a decisive role, as the storage ability depends more or less on the storage temperature of the exposed dosemeter in relation to the position of the glow maximum. Therefore, detailed fading measurements were performed at different temperatures using BeO. In view of the numerous analogies observed between TSEE and TL the theory of glow curves also can be applied to the exoelectron effect. Based on the kinetic model for the discharge of occupied traps, activation energies can be calculated from the half-life experimentally determined at two different but constant temperatures. By means of the activation energies it is then possible to calculate the corresponding frequency factors. (auth)

33221 (INIS-mf-1597, pp 247-251) A PRACTICAL TSEE DOSIMETRY SYSTEM BASED ON BeO CERAMIC. Gammage, R. B.; Cheka, J. S. Feb 1974.

From 4th international symposium on exoelectron emission and dosimetry; Liblice, Czechoslovakia (25 Sep 1973).

In 4th international symposium on exoelectron emission and dosimetry.

The present situation regarding the practical application of BeO ceramic TSEE dosimeters is assessed critically. Reproducibility of response is the central issue and one which is still causing problems. Nevertheless, the methods of detector preparation, use and readout are established which permit successful testing under field conditions. Examples are given of personnel and environmental monitoring, and of the monitoring of β emitters such as ^{3}H and ^{204}Tl for which the TSEE dosimeter is intrinsically suitable. (auth)

33222 (INIS-mf-1597, pp 252-254) SIMULTANEOUS TL AND TSEE MEASUREMENTS ON SOME TLD MATERIALS. Petel, M.; Holzapfel, G. Feb 1974.

From 4th international symposium on exoelectron emission and dosimetry; Liblice, Czechoslovakia (25 Sep 1973).

In 4th international symposium on exoelectron emission and dosimetry.

Improved correspondence of simultaneous TL and TSEE was achieved from separate samples of the same material (LiF, Al_2O_3) in a two-heater differential device by adding graphite to the TSEE sample. All spectra of chemically identical compounds exhibited nearly coincident TL and TSEE peak locations. The electron traps used in LiF TLD were not created by the dopants (Mg, Ti) and hole processes could be excluded. (auth)

33223 (INIS-mf-1597, pp 255-257) APPLICATION OF EXOELECTRON EMISSION FOR INTERFACE- AND MICRODOSIMETRY. Ennow, K. R. Feb 1974.

From 4th international symposium on exoelectron emission and dosimetry; Liblice, Czechoslovakia (25 Sep 1973).

In 4th international symposium on exoelectron emission and dosimetry.

The results are given of dose measurement at a metal-perspex interface relative to the dose at electronic equilibrium at different distances from the metallic foil. (INIS)

33224 (INIS-mf-1597, pp 258-260) FAST-NEUTRON DOSIMETRY USING F CENTERS IN MgO. Ritz, V. H.; Hash, A. E.; Attix, F. H. Feb 1974.

From 4th international symposium on exoelectron emission and dosimetry; Liblice, Czechoslovakia (25 Sep 1973).

In 4th international symposium on exoelectron emission and dosimetry.

A major shortcoming of presently available fast-neutron dosimeters is their low response per tissue rad to fast neutrons, S_n, in comparison with their corresponding γ-ray response, S_γ. Typically $S_n/S_\gamma = 0.1$. A fast-neutron dosimeter will be described, the operation of which is based on the detection of F centers produced in MgO by displacement collisions. The F-center production rate is greatly enhanced by hydrogenous surroundings from which recoil protons are ejected. The absorbed dose is measured by means of the 350°C exoelectron emission peak. The response is linear from 10 to 1000 rad (tissue). $S_n/S_\gamma \approx 0.90$ with hydrogenous surroundings and is independent of neutron energy (±10%) between 2 and 15 MeV. $S_n/S_\gamma \approx 0.06$ without hydrogenous surroundings. Very little fading of the stored signal is observed, but the radiation sensitivity decreases by about 25% per month over a period of two months. A peak at 440°C offers the possibility of increasing the sensitivity of the system. (auth)

33225 (INIS-mf-1597, pp 261-266) FURTHER STUDIES ON TSEE IN MULTISCALAR AND PULSE HEIGHT ANALYZER MODES. Moreno y Moreno, A. Feb 1974.

From 4th international symposium on exoelectron emission and dosimetry; Liblice, Czechoslovakia (25 Sep 1973).

In 4th international symposium on exoelectron emission and dosimetry.

Problems of reproducibility and handling of data, such as thermal and electrical contacts, the specific surface condition of dosimeters, and the criterion chosen for recording the data are discussed. Advantages related to flexibility, recording and digitalization of data when using a multichannel analyzer operated in both the multiscaler and pulse height analyzer modes, are pointed out. (INIS)

33226 (JAERI-M-5863) BeO:Na EXOELECTRON EMISSION DOSIMETER. 1. Response of BeO:Na for Gamma Radiation. Ohtani, S.; Kawai, K.; Numakunai, T. (Japan Atomic Energy Research Inst., Tokyo). Oct 1974. 16p. (In Japanese). INIS.

Dosimetric characteristics of Na-doped BeO (BeO:Na) and properties of the instrument prepared for measuring the thermally stimulated exoelectron emission are described. The BeO:Na sample was irradiated by ^{60}Co γ-rays after annealing at 500°C for one hour. The sample was then heated electrically; the heating rate was from 0.4 to 3.0°C/sec, in the range of temperature to 500°C. Emitted exoelectrons were detected by a gas-flow GM-counter. The output of the counter was recorded as an integrated count and analogue and digital mode of the glow-curve. The BeO:Na powder sample exhibits a glow-curve having a main peak at 380°C and a small peak at 460°C; reproducibility of integrated count is ±3% of the mean value. The integrated count of the main peak was corrected for the counting loss of the counter, approximating the glow-curve to be the Gaussian distribution. The response of BeO:Na powder sample for γ-rays is then proportional to $(\text{dose})^{0.91}$. The lower detectable dose limit is 0.01 mR. Characteristics of the Aquadag-coated ceramic sample is also described. (auth)

33227 DOSEMETERS AND DOSE INTENSITY SIGNALIZERS. Bazylczuk, E. (Zjednoczone Zaklady Urzadzen Jadrowych POLON, Bydgoszcz (Poland). Zaklad Urzadzen Dozymetrycznych). Probl. Tech. Med.; 4: 295-309(1973). (In Polish).

From 3rd symposium of Polish Medical Physics, Society; Zabrze, Poland (10 May 1972).

The control and metric apparatuses, purposed for dosimetry of the work-place and for individual measurements are presented. These devices are produced by ZZUJ "POLON" Factory of Dosimetric Instruments in Bydgoszcz. The apparatuses serve either to determine the degree of exposure due to the presence of gamma radiation field (large and small dose intensity) and neutrons or mixed radiation fields with variable composition and spectrum, or to signalize the tresspassing of a determined range of dose intensity or dose itself. The presented equipment utilizes detectors based on the principles of: ionization chamber, G-M counter, scintillator or thermoluminescence effect. Each type of equipment is evaluated in this work in the aspect of its utilizability, exactness of measurements and dependency of indications in the function of radiation energy etc. (auth)

33228 EVALUATION OF THE THERMOLUMINESCENT DETECTION DOSEMETERS PRODUCED IN POLAND. Glowacka, A. (Instytut Medycyny Pracy w Przemysle Wlokienniczym i Chemicznym, Lodz (Poland)). Postepy Fiz. Med.; 8: 33-37 (1973). (In Polish).

From 3rd symposium of Polish Medical Physics Society; Zabrze, Poland (10 May 1972).

Methods and results are presented of measurements with DTM-1 and DTM-2 dosemeters. They were found to be useful for x-ray dose measurements in a wide range of exposures and energies, the accuracies being not less than 10% and 15% for the DTM-2 and DTM-1, respectively. (auth)

33229 CALORIMETRIC MEASUREMENT OF RADIOACTIVE SAMPLES. Chapter 3. Shimanskaya, N. S. pp 71-117 of Ionizing Radiation Calorimetry. Moscow; Atomizdat (1973). (In Russian).

This chapter of the monograph presents the general principles of calorimetrically measuring the activity of alpha and beta emitters. A description is given of the features of measuring the activity of natural radioactive isotopes and their decay energy. A review is given of beta and gamma calorimeters, and also of calorimeters for measuring the activity of high-level, radioactive materials. (tr-SJR)

33230 IONIZING RADIATION CALORIMETRY DEVELOPMENT. Chapter 2. Shimanskaya, N. S. pp 61-70 of Ionizing Radiation Calorimetry. Moscow; Atomizdat (1973). (In Russian).

This chapter of the monograph gives a historical review of the development of the calorimetry of ionizing radiation. The classical experiments of Ellis and Wuster are considered with a brief description of studies carried out in the 1936-1970 period. The development of the calorimetry of ionizing radiation in the USSR is considered separately. (tr-SJR)

33231 REACTOR RADIATION DOSIMETRY. Chapter 8. Shimanskaya, N. S. pp 202-260 of Ionizing Radiation Calorimetry. Moscow; Atomizdat (1973). (In Russian).

This chapter of the monograph considers the principles of the calorimetric method of measuring reactor radiation, and the types of calorimeters used for this purpose. A description is given of the features of calorimetrically determining energy spectrum of reactor gamma radiation and the fast neutron flux. The use of the calorimetric method is considered for determining the burnup of nuclear fuel and deformation of the thermal neutron field. (tr-SJR)

33232 CALORIMETRY: TECHNIQUE AND APPARATUS. Chapter 1. Shimanskaya, N. S. pp 5-60 of Ionizing Radiation Calorimetry. Moscow; Atomizdat (1973). (In Russian).

This chapter of the monograph considers the general principles of calorimetric measurements, and presents a classification of calorimeters. A description is given of the features of gas and liquid thermometers, thermocouples, resistance thermometers, and isothermal, adiabatic and static calorimeters. Measurement schemes of calorimeters and their calibration are considered. Features of calorimetric measurements of ionizing radiation are noted. (tr-SJR)

33233 USE OF CALORIMETRY FOR DOSIMETRY PURPOSES. Chapter 7. Shimanskaya, N. S. pp 181-201 of Ionizing Radiation Calorimetry. Moscow; Atomizdat (1973). (In Russian).

This chapter of the monograph considers features of using calorimetric methods for determining absorbed dose and dose rate, and for calibrating chemical dosimeters. A description is presented of the construction of calorimeters used for these purposes. (tr-SJR)

33234 MINING INSTRUMENTATION FOR PHOTO-NEUTRON ANALYSIS. Shestakov, V. V. (AN SSSR, Sverdlovsk. Inst. Geologii i Geokhimii). Geofiz. App.; No. 53, 62-64(1973). (In Russian).

Portable equipment is described for the photoneutron testing of ores and processed concentrates and wastes. The equipment uses a remote-controlled rod to change the space orientation of the counter. A method for the express testing of ores and concentrates is proposed. (tr-auth)

33235 IMMEDIATE ESTIMATION OF EMERGENCY NEUTRON DOSES USING A RAD-RESPONSE RECOIL TRACK DETECTOR. Hassib, G. M.; Medveczky, L. (Magyar Tudomanyos Akademia Atommag Kutato Intezete, Debrecen). Nucl. Instrum. Methods; 123: No. 2, 395-396(15 Jan 1975).

An immediate estimation of emergency neutron doses in the event of reactor accident using the coloured cellulose nitrate film (Kodak L R-115) is described. The detector sensitivity is found to follow the rad per neutron fluence curve at energies between 1 and 14 MeV. (auth)

33236 LATENT FADING OF GAMMA AND NEUTRON MONITORING FILMS. Piesch, E.; Sayed, A. M. (Karlsruhe Nuclear Research Centre, Health Physics Division, Karlsruhe, Germany). Nucl. Instrum. Methods; 123: No. 2, 397-402(15 Jan 1975).

Results found for the environmental effects on the Gevaert β/γ film are compared with the fading of Kodak P.M.3 and Ilford P.M.1 films. Results are given also for the fading of the Kodak NTA Personnel Neutron Monitoring film, Type A exposed to ^{252}Cf fission neutrons. Both film types were stored for a period of up to 3 weeks at temperatures of 0 to 50°C and relative humidities of 0 to 97%. The fading characteristics of the Kodak NTA film sealed and equilibrated under various conditions from different services have been investigated. In the Agfa Gevaert film 40% fading occurred after a period of 8 days at 25°C and 97% r.h. The Kodak NTA film shows a high fading of up to 50% after a period of 3 weeks at normal temperature and relative humidity. The tracks disappeared at higher temperatures and humidities. (auth)

33237 CALCULATION OF THE RESPONSE OF SILICON DETECTORS OF FINITE RADIUS TO π^- MESONS STOPPING IN TISSUE. Armstrong, T. W.; Chandler, K. C. (Oak Ridge National Lab., Tenn. (USA)). Nucl. Instrum. Methods; 123: No. 2, 363-364(15 Jan 1975).

In previous paper the response of silicon detectors placed in a large region of π^- mesons stopping in tissue was computed using a one-dimensional approximation, i.e., both the detector and the capture volume were assumed to have an infinite radius. The calculational method described has since been modified to take into account the radius as well as the thickness of the detector, and the purpose of the present paper is to show the effect of detector radius on the computed pulse-height spectra and energy-deposition spectra. (auth)

33238 MEASUREMENT OF HIGH-INTENSITY PULSED X-RAYS BY A SCINTILLATION METHOD. Yasuda, K.; Ikuta, S.; Takeda, M.; Masuda, H. (Government Industrial Research Inst., Nagoya (Japan)). Nagoya Kogyo Gijutsu Shikensho Hokoku; 23: No. 6, 187-191(Jun 1974). (In Japanese).

A scintillation method using a plastic scintillator was studied to measure the dose rate of high-intensity pulsed x-rays from an electron linear accelerator. In order to measure the high-intensity x-rays the plastic scintillator was separated from a photomultiplier by a light pipe and a slit used as a light attenuator was placed in front of the photomultiplier. Peak intensities as high as about 10^7R/min of pulsed x-rays with a pulse length of 4 μsec and with a repetition rate of 200 pps were measured by this method. The loss of fluor sensitivity of the plastic scintillator due to radiation damage was observed when the total dose exceeds about 3×10^5 R of ^{60}Co gamma rays. (auth)

33239 EXPOSURE STANDARD FOR MEDIUM ENERGY X-RAYS. Matsumoto, T.; Katoh, A. (Electrotechnical Lab., Tokyo (Japan)). Denshi Gijutsu Sogo Kenkyusho Iho; 38: No. 6-7, 251-263(Aug 1974). (In Japanese).

This paper gives in detail absolute measurements of exposure carried out with exposure standards for medium energy x-rays as well as the results of international comparison of the standards conducted in 1968 between the Electrotechnical Laboratory and the National Bureau of Standards, U. S. A. The standards have been reconstructed by sufficiently stabilizing the X-ray output and ionization measuring system since 1963. Methods to monitor the X-ray tube voltage and current are employed to eliminate the influence of the X-ray output fluctuation in the dose measurement, and the scattered X-rays from the X-ray tube vessel are taken into account in determination of the correction coefficient for X-ray attenuation by air. As a result of the international comparison using a small type cavity ionization chamber for moderately filtered X-rays produced at peak potentials of 60, 100, 150 and 200 kV_p respectively, it has been confirmed that the exposure standards of the two countries agree with each other within ±0.2% in the energy range above 100 kv_p. (auth)

33240 THERMOLUMINESCENCE OF LiF TLD-100 DOSIMETER CRYSTALS. Fairchild, R. G.; Mattern, P. L.; Lengweiler, K.; Levy, P. W. (Brookhaven National Lab., Upton, NY). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 366-372(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

The unusually complex thermoluminescence obtained from Harshaw dosimeter type TLD-100 LiF crystals has been studied with apparatus for measuring emission intensity simultaneously as a function of both wavelength and sample temperature. A separate signal averaged spectrum is obtained at 5.5 C temperature intervals. Data reduction includes all corrections needed to obtain curves of absolute intensity vs photon energy. Numerous results were obtained from crystals exposed to ^{60}Co gamma-ray doses extending from 5×10^2 to 5×10^7R. All emission spectra could be resolved into Gaussian shaped bands using a computerized best-fit procedure. Below 10^5 R all spectra contain three bands at roughly 3.01, 2.90, and 2.71 eV with full widths of 0.90, 0.72, and 0.96 eV; the precise values vary slightly with temperature. Above 10^5 R additional bands appear at 2.98 and 2.50 eV, and with increasing exposure the 2.90 and 2.71 eV bands diminish in intensity. At doses greater than 4 or 5×10^6 R additional bands appear at 4.0, 2.3, and 1.5 eV. In the range usually used for dosimetry, at least the 3 bands at 3.01, 2.90, and 2.71 eV contribute to the thermoluminescence. Glow curves for each of these emission bands were constructed from the resolved Gaussian shaped bands. They contain 8, 3, and 5 prominent peaks. In contrast, glow curves for unresolved spectra contain at least 8 glow peaks, and each peak can contain undetermined contributions from 1, 2, or 3 emission centers. All glow peaks analyzed to date can be fitted by the first-order expression $dn/dt = -ns \exp(-E/kT)$. However, the E and s values obtained for the 190 C peak and perhaps some of the other high temperature peaks are too large to be meaningful; thus the kinetics for this peak, and possibly other high temperature peaks, must be complex. To date, thirteen glow peaks have been identified. At low doses the emission is confined to the low temperature glow peaks. With increasing dose the emission intensity increases and progressively shifts to higher temperature peaks. The maximum intensity occurs at 10^6 R. At higher doses the emission is reduced but occurs among the highest temperature peaks. (auth)

33241 IMPROVED CALORIMETRIC METHOD FOR ENERGY DEPOSITION MEASUREMENT. Miller, G. H.; Lockwood, G. J.; Halbleib, J. A. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 359-365(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

An improved technique has been developed for the measurement of electron energy deposition versus depth profiles using thin foil calorimeters. A square-wave modulated beam is employed, and the time derivative of the thermocouple signal is measured at a specified time after beam switch. The method and apparatus are described, and results are presented for Al and Ta for 0.3, 0.5, and 1.0 MeV normally incident electrons. Data are also presented for the same energies and 60° (relative to normal) incidence in Al. Deposition data in a layered Ta and Al system at 1.0 and 0.5 MeV energy (normal incidence) are also presented. (auth)

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Refer also to abstracts 32472 and 35047.

33242 (INS-TCH-9) A COMPUTER PROGRAM FOR THE ANALYSIS OF GAMMA-RAY SPECTRUM. Concerning the Background Subtraction. Komura, K. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 24 Jun 1974. 26p. (In Japanese). INIS.

A computer program has been developed for the analysis of gamma-ray spectrum obtained with a Ge(Li) detector. A new set of analytic functions is introduced in the approximation of the spectral shape. A Gaussian function with exponential tail is used for the peak shape, while an arctangent function is adopted for the background subtraction. Comparison of the new background function with previous ones, 1-st, 2-nd, 3-rd and exponential function, showed that the arctangent function gives much superior result to that obtained by other functions, particularly to the analysis of closely adjacent doublet peaks. Several adequate measures are taken for a number of the cases of divergence occurring in least squares fitting. The program can resolve overlapping peaks of less than 10 (if simple Gaussian function is applied, then 11) by assuming all the peaks in such a group have the same width. The core size of 24 K is required for the analysis of the 4096 channel spectrum. The calculating time on the TOSBAC 3400/M51 machine is about 300 seconds for a 4096 channel spectrum. (auth)

33243 (JAERI-M-5567, pp 219-230) A FIRST-ORDER THEORY FOR THE DESIGN OF CHARGED PARTICLE SPECTROMETERS AND SPIN ROTATORS WITH CROSSED ELECTRIC AND MAGNETIC FIELD. Ikegami, H. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Several new principles governing the design of optical systems with crossed electric and magnetic field are presented. In particular, the dispersion and the resolution of mass, velocity, energy, and momentum are expressed as simple integrals of particular first order trajectories characterizing the systems. It is shown that non zero entrance and exit angles to the electric field boundaries are useful parameters in the design of the systems. As useful examples, the systems of zero velocity dispersion type and of zero mass dispersion type are discussed. It is seen that the former is suited as a recoil nucleus spectrometer while the latter as a spin rotator. (auth)

33244 (KURRI-TR-117, pp 2-10) LOW-LEVEL RADIOACTIVITY MEASUREMENT. The Measurement with Semiconductor Detectors. Okano, M. 1973. (In Japanese).

From study meeting on low-level radiation measurements; Kumatori, Osaka, Japan (22 Jan 1973).

In proceedings of the study meeting on low-level radiation measurements.

The low-level radioactivity measurement for γ-ray-emitting nuclides by semiconductor spectroscopy is superior due to its high resolution. Radioactivity measurement in general is limited by detection efficiency, energy resolution, background, etc. In the determination of nuclides, their nuclear characteristics must be known, including γ-ray energy and release rate; fortunately, after penetration through matter, γ-rays (and x-rays) also provide invariable information. The semiconductors currently available have the energy resolution approaching the theoretical limit, and their handling is relatively easy. Low-level radioactivity measurement by semiconductor spectroscopy is described including principle and apparatuses, measuring method, basic data, data processing, and problems for the future. (JA)

33245 (KURRI-TR-117, pp 16-19) LOW LEVEL GAMMA SPECTROMETER IN KOBE UNIVERSITY OF MERCANTILE MARINE. Michijima, M.; Miyake, H. 1973. (In Japanese).

From study meeting on low-level radiation measurements; Kumatori, Osaka, Japan (22 Jan 1973).

In proceedings of the study meeting on low-level radiation measurements.

The Ge(Li) gamma spectrometer for the purpose of studying the behavior of radioactive nuclides in the ocean has the advantage of being able to reduce background effectively around the Compton edge, by putting a sample directly on a Ge(Li) detector, covering them with NaI(Tl) scintillator, and taking anti-coincidence counts. The measurement of samples with low level activity has become easier by installing the system in a large room shielded with lead of 100 mm thickness. The intensity ratio of a photopeak to the corresponding Compton edge was improved to 210 : 1 from 32 : 1 for ^{137}Cs. The height of the annihilation γ ray peak was decreased to $1/3$. Very small peaks on the Compton background are detected much easier by anti-coincidence counting. The total background counting rate was reduced to $1/100$ around 100 keV, to $1/50$ around 500 keV, and to $1/20$ around 2 MeV. It was further reduced to $1/2$ around 1 MeV when it was measured by the anti-coincidence mode using a well-type NaI scintillator. At present, polluting nuclides of several pCi including ^{137}Cs, ^{95}Zr and the like are detectable in a 50 hour measurement. (JA)

33246 (KURRI-TR-117, pp 66-68) LOW LEVEL ALPHA RAY MEASUREMENT. Kikuchi, J. 1973. (In Japanese).

From study meeting on low-level radiation measurements; Kumatori, Osaka, Japan (22 Jan 1973).

In proceedings of the study meeting on low-level radiation measurements.

Almost all radiation detectors are useable for α-ray detection. However, the one that shows the most excellent performance for α-ray spectrometry is pulse ionization chambers. The pulse ionization chambers are divided into parallel plate type and cylindrical type, each comprises both with grid and without grid types. The parallel plate type is suitable for producing general α-ray spectrometers which have small sample area, high resolution, and fast rise time. In the cylindrical type, the sample area can be made large without increasing input capacity if a center electrode is made collector and an outer electrode the sample surface. The author et al. have argued respective merits and demerits of cathode pulse and grid pulse, those of presence of grids, and the fundamental characteristics of the cylindrical ionization chambers; and also have indicated the possibility of using the cathode pulse for background reduction. Resolution of 45 keV has been achieved for the α-ray of ^{210}Po, with the background being 0.17 cph per FWHM around 5 MeV. The quantitative determination of Th and V in the bottom soil of deep sea has been realized. (JA)

33247 (KURRI-TR-117, pp 72-77) BETA SPECTROSCOPY OF VERY LOW ACTIVITY. Tanaka, E. 1973. (In Japanese).

From study meeting on low-level radiation measurements; Kumatori, Osaka, Japan (22 Jan 1973).

In proceedings of the study meeting on low-level radiation measurements.

The coincidence type β-ray spectrometer (PICOBETA) is a scintillation spectrometer which reduces background by coincident counting with a GM counter. It is suitable for the measurement of very low β activity. The detector of PICOBETA is a plastic scintillator whose cavity contains a GM tube. The window of the GM tube consists of a thin Mylar film on which gold is vacuum evaporated inside and aluminium outside. The reduction of background, 0.16 to 0.25 cpm (0.035 to 3.5 MeV), is achieved by shielding, coincident counting, pulse height analysis and scrutiny of composing material. Energy is indicated on a logarithmic scale to realize easy reading. The determination of the maximum energy E_{max} can be performed by utilizing the agreement of the extrapolated point of the pulse height distribution on the logarithmic scale with E_{max}. Self-absorption and backscattering from a sample holder scarcely affected the extrapolated point. Application of PICOBETA is described in nine or ten ways. (JA)

33248 (KURRI-TR-117, pp 78-84) ACTUAL EXAMPLES OF LOW LEVEL RADIATION MEASUREMENT IN SPACE CHEMISTRY. Imamura, M. 1973. (In Japanese).

From study meeting on low-level radiation measurements; Kumatori, Osaka, Japan (22 Jan 1973).

In proceedings of the study meeting on low-level radiation measurements.

The field in space chemistry to investigate nuclide conversion processes in nature is called space nuclear chemistry. The radiation measurement in that chemistry is one of the fields which challenges the lowest level measurement. Some measuring systems which played active parts in the radioactivity analysis of lunar samples are described. The beta-gamma measuring system was used to measure ^{22}Na, ^{26}Al, ^{46}Sc, etc. by coincident measurement with type NaI counter and a built-in GM counter. An x-measuring system was used for the measurement of ^{49}V, ^{53,54}Mn, ^{56,57,60}Co and ^{59}Ni with a gas flow proportional counter equipped in a well type NaI counter. The x-ray measuring system adopted a Lucite wall proportional counter to measure ^{51}Cr, ^{53,54}Mn, and ^{55}Fe. Liquid scintillator –NaI(Tl) system was adapted to the measurement of ^{54}Mn, ^{56}Mn and ^{56}Co. Also for ^{54}Mn and ^{7}Be measurement, a well type Ge(Li) detector was employed. The approximate composition, coincident counting method and others are described in detail for these measuring systems. (JA)

33249 (KURRI-TR-117, pp 85-99) LOW LEVEL X-RAY MEASURING APPARATUS. Takahashi, H. 1973. (In Japanese).

From study meeting on low-level radiation measurements; Kumatori, Osaka, Japan (22 Jan 1973).

In proceedings of the study meeting on low-level radiation measurements.

Proportional counters are most suitable for x-ray measurement when detection efficiency, resolution, noise and others are evaluated generally, if low level measurement is concerned. The author has produced such a low level x-ray measuring apparatus with the proportional counter as a detector for the purpose of investigating EC nuclides (^{41}Ca, ^{59}Ni, ^{53}Mn, ^{55}Fe, etc.) in space substances. The apparatus itself is shielded with 0.7 cm thick mercury, multi-wire type GM tubes for anti-coincidence counting, a 1 cm thick oxygen-free copper plate, a 12 cm thick iron from the former battleship "Mutsu", and a 10 cm thick lead shield from the inside toward the outside. The linearity and energy resolution of the proportional counter were satisfactory. As for background counting, it was made apparent that the effect of the anti-coincidence system which has operated completely well for the pulses from a pulse generator was affected by delay time in the case of actual background pulses. This is due to the fact that the background pulses are the collection of various wave-form pulses. A future improvement program is described. (JA)

33250 (SSD-68) DEVELOPMENT OF A GAMMA-RADIATION DOWN-HOLE PROBE. Final Report. Purvis, A. E. (Texas Instruments, Inc., Dallas (USA)). 30 Sep 1968. Contract AT(05-1)-912. 18p. GJO.

For Lucius Pitkin, Inc., Grand Junction, CO.

The probe was designed to advance the state-of-the-art for down-hole logging by improving the temperature and high counting rate stability and by providing pulses suitable for pulse-height analysis at the end of a 3000-ft cable. Resolution of the system developed is approximately 10.2 percent with a maximum output of more than 1 volt for the 0.662-MeV gamma radiation from ^{137}Cs. These values can be observed at the end of the 3000-ft cable. The output signal amplitude variation for the system caused by environmental-temperature changes is –0.2 percent/°C from 21°C in the range, –17°C to +55°C. Gain shift of the system is less than one percent change from essentially zero counting rate to a rate of 50,000 counts/second. Texas Instruments Gamma-Radiation Down-Hole Probe utilizes a $1\frac{1}{4}$-in. dia × 1-in. thick NaI(Tl) crystal viewed by an RCA 4440 photomultiplier tube to provide the output pulses at the end of a 3000-ft cable. The detector and electronics were installed in a government-furnished probe shell, tested and delivered to Grand Junction on 26 September 1968. (auth)

33251 MULTIDIMENSIONAL GAMMA SPECTROMETRY AND ITS APPLICATION IN LOW-RADIOACTIVITY PHYSICS. I. Analysis of Spectrometric Methods and Spectrometer Design. Usacev, S.; Povinec, P.; Chudy, M. Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; No. 14, 79-104(Dec 1973). (In Slovak).

An analysis of anticoincidence and coincidence spectrometric methods of low-level gamma counting is presented. High-sensitivity multidimensional gamma-gamma spectrometers permit activity measurements of the order of 10^{-12} Ci. (auth)

33252 NEUTRON SPECTRUM MEASUREMENT IN FAST REACTOR SYSTEM BY ^{6}Li SANDWICH SPECTROMETER. Kanda, K.; Baba, M.; Yokoyama, T.; Hirakawa, N. (Tohoku Univ., Sendai (Japan). Faculty of Engineering). pp 243-254 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese).

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

Neutron spectra have important meaning from the viewpoint of examination of a cross section set and nuclear calculations. For the neutron spectrum measurement in fast reactor system, a ^{6}Li sandwich spectrometer was developed. It has one figure higher detecting efficiency than usual counters, and resolving power was improved to ½. The characteristic test of the ^{6}Li sandwich spectrometer was performed with 5 MV van de Graaff concerning the response and detecting efficiency to monoenergetic neutrons and concerning the energy dependence of background. The following points were clarified. The peak level of neutron energy varies linearly to proton energy. The response of the counter shows little energy dependence. In the energy range of thermal neutrons to 3.78 MeV, the background due to Si(n,p) and Si(n,α) reactions could not be found. In the neutron spectrum measurement in Fast Critical Assembly and fast neutron source reactor "YAYOI", the gain reduction of the ^{6}Li sandwich spectrometer was experienced because of radiation damage. The neutron spectrum measured with this spectrometer showed a drop at the resonance of ^{6}Li (n,α)^{3}H reaction at 250 keV. (JA)

33253 THE FLORIDA STATE UNIVERSITY QUADRUPOLE SPECTROMETER. Morgan, G. R.; Gunn, G. D.; Greenfield, M. B.; Fletcher, N. R.; Fox, J. D.; McShan, D.; Wright, L. (Florida State Univ., Tallahassee (USA). Dept. of Physics). Nucl. Instrum. Methods; 123: No. 3, 439-444(1 Feb 1975).

A quadrupole doublet lens refocuses particles of rigidities up to 400 MeV/c per unit charge scattered within an angular range of -15° to + 140° from a 30 cm chamber onto a detection surface 3.0 m removed from the target. This system, herein to be called the quadrupole spectrometer, has been developed for the purpose of (1) reduction of noise and background during detection of charged particles, (2) magnetic rigidity band pass filtering and reduction of unwanted or overprolific beam species, (3) small-angle cross section measurements, (4) charge state determinations, and (5) time-of-flight measurements. A general description of the quadrupole spectrometer, a discussion of its intended uses and examples of data obtained are presented. (auth)

33254 ON-LINE CAMAC COUPLING OF THE HEIDELBERG $1/2\,\pi\sqrt{13}$ β-RAY SPECTROMETER. Wiemers, M.; Martin, B. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Nucl. Instrum. Methods; 123: No. 3, 505-508(1 Feb 1975).

The Heidelberg high resolution ironfree $\pi\sqrt{13}$ β-ray spectrometer has been connected to a SIGMA 3 computer (RXDS) by a CAMAC Crate and a CAMAC System Controller. Data processing and control of the spectrometer can now be effected on-line. For that purpose the development of the System Controller and of the associated computer program were necessary. (auth)

33255 A LARGE DOUBLE SCATTER TELESCOPE FOR GAMMA RAYS AND NEUTRONS. Herzo, D.; Koga, R.; Millard, W. A.; Moon, S.; Ryan, J.; Wilson, R.; Zych, A. D.; White, R. S. (California Univ., Riverside (USA). Dept. of Physics). Nucl. Instrum. Methods; 123: No. 3, 583-597(1 Feb 1975).

A large aperture, area and solid angle double scatter telescope for measurements of the flux, energy, angle and time distributions of gamma rays and neutrons from a ballon is described. It is sensitive to gamma rays from 0.5 to 30 MeV and to neutrons

from 2 to 100 MeV. A gamma ray is identified by Compton scatters in each of two large liquid scintillator tanks of cross section 1 m x 1 m spaced 1 m apart. For better angular resolution each tank is divided into 28 cells and each is viewed by its own photomultiplier. A neutron is identified by an elastic scatter from a proton in the first tank and a scatter by a proton or an inelastic scatter from carbon in the second tank. Measurements of the Compton electron recoil energies in each scintillator give estimates of the incident gamma ray energy and restrict its incident angle to a cone. Measurements of the proton recoil energy in the first scintillator and the time of flight between scintillators give the neutron's energy and incident angle to a cone. Time of flight separates the gamma rays from the neutrons and determines their direction through the telescope. For point sources the gamma ray detection efficiency is a maximum of 3% at 4 MeV and drops to 1% at 0.5 MeV and 0.4% at 30 MeV. The corresponding geometrical factors are 300, 100 and 40 cm^2, respectively. The greatest efficiency occurs at 10° and falls by a factor of 3 at 60° for a 5 MeV gamma ray. For a neutron point source, its peak efficiency is 8% at 6 MeV and falls rapidly to 1% at 3 MeV and slowly to 0.4% at 100 MeV. The geometrical factors are 800, 100 and 40 cm^2, respectively. Its efficiency is maximum for a 45° scatter and drops slowly for smaller and larger angles. For the large cells the gamma ray and neutron energy resolutions are both about 20% hwhm for the useful energies, and the cone angle resolutions are about 10° hwhm. Energy and angle resolution for the smaller cells are somewhat better. The detector has a high background rejection particularly because of the high hydrogen to carbon ratio of the scintillator of 2.0, the nanosecond time resolution and the 10° hwhm angular resolution. (auth)

33256 INTEGRATION OF SMALL PHOTOPEAKS LYING ON THE HIGH BACKGROUND IN Ge/Li SPECTROMETRY. Taczanowski, S. (Institute of Nuclear Physics, Krakow (Poland)). Nucl. Instrum. Methods; 123: No. 2, 409-410(15 Jan 1975).

A technique of photopeak integration with the use of only three channels in a multichannel gamma spectrum is presented. The good precision of the method is shown and the advisable width of the channels (expressed in fwhm of the peak) is given. (auth)

33257 MEASUREMENTS OF BACKWARD SCATTERING OF NEUTRONS. Minetti, B.; Pasquarelli, A. (Politecnico di Torino (Italy)). Nucl. Instrum. Methods; 123: No. 2, 365-369(15 Jan 1975).

The angular and time resolution of a neutron time-of-flight spectrometer is discussed. The spectrometer utilizes fast neutrons from the reaction $^3H(d,n)\,^4He$ and the method of the associated particle; it is used on an experimental arrangement able to measure the differential cross sections at backward angles (140° to 178°) for elastic and inelastic scattering of 14 MeV neutrons. (auth)

33258 PAIR CREATION GAMMA-RAY SPECTROMETER WHICH COMPRISES A SEMICONDUCTIVE MONOCRYSTAL. Yoshida, H. (to Japan Atomic Energy Research Inst., Tokyo). Japanese Patent 1973-11674/B/. 7 May 1968. 6p. (In Japanese).

An electron-pair creation gamma-ray spectrometer is provided in which a conventional separate semiconductor detector is integrally formed in one chip of a single crystal. The p-i-n junction type of semiconductive monocrystal is divided into three regions, right (R), mediate (M) and left (L) regions by forming two notches which extend the i-layer from either surface of the p-or n-layer. The i-layer of the mediate region M functions as the main detector of a conventional semiconductor device when a gamma-ray is incident thereon. Other regions L and R function as auxiliary detectors which detect the gamma-rays scattered by Compton effect in the M region. The output pulses from regions L and R are amplified by linear amplifiers LA_L and LA_R then fed to single-channel pulse height analyzers $S\text{-}PHA_L$ and $S\text{-}PHA_R$ respectively to discriminate the signals as a result of pair production. The discriminated pulses are fed to a coincidence circuit together with the output pulse from the mediate region M amplified by an amplifier LA_M. The coincidence circuit provides a gate signal when the three pulses are fed simultaneously. The gate signal opens a gate G to feed the output signal of LA_M to a multi-channel pulse height analyzer, and thus the spectrum of the double escape peak is obtained. (JA)

High Energy Physics Instrumentation

Refer also to abstract 35658.

33259 (CERN-74-23, pp 367-393) ERASME: AUTOMATIC PROCESSING OF BUBBLE CHAMBER PHOTOGRAPHS. Jank, W. (CERN, Geneva). 15 Nov 1974.

In proceedings of the 1974 CERN school of computing, Godoeysund, Norway, 11-24 August 1974.

ERASME is a system for the automatic processing of photographs of bubble chamber events. It represents a new approach in that it fuses into a single facility the usually independent steps such as scanning and premeasuring, measuring, spatial reconstruction, and rescuing. The scan and measure unit, using CRT, and the computer hardware and software are described. (WHK)

33260 (KURRI-TR-115, pp 5-7) NEW MEASURING INSTRUMENTS. The Direction of Their Development. Fukui, S. 1973. (In Japanese).

From study meeting on radiation measuring instruments; Kumatori, Osaka, Japan (9 Dec 1972).

In proceedings of the study meeting on radiation measuring instruments.

In the fields of high energy physics and elementary particle physics the age of drastic advance is already past and the current stage is rather stationary. It is in such a state as to require the definite information based on precise data and analysis. Under the situation, available, established measuring instruments and detectors must be restudied thoroughly. In line with this, the following points are described: the current state of high energy experiments with accelerators; the performance of currently available measuring instruments; and measuring instruments suitable for high-energy experiments in the future, and the direction of their development. (JA)

33261 (KURRI-TR-115, pp 8-11) THE PRINCIPLE AND APPLICATION OF NEW MEASURING INSTRUMENTS. Doke, T. 1973. (In Japanese).

From study meeting on radiation measuring instruments; Kumatori, Osaka, Japan (9 Dec 1972).

In proceedings of the study meeting on radiation measuring instruments.

In the author's laboratory, research and development are proceeding on two radiation detectors of different principles. One is an ionization pulse detector utilizing liquid rare gas, such as Ne, Ar, Kr or Xe, and the other is a hydrogen bubble chamber of high repetition rate using ultrasonic waves. The principles, characteristics and applications of these two new detectors are described, and the current status of developments is also briefed. (JA)

33262 (KURRI-TR-115, pp 15-19) ON THE READ-OUT SYSTEM OF THE WIRE CHAMBERS. Inaba, S. 1973. (In Japanese).

From study meeting on radiation measuring instruments; Kumatori, Osaka, Japan (9 Dec 1972).

In proceedings of the study meeting on radiation measuring instruments.

A summary of recent work on the read-out system of wire chambers is given. Last year, a read-out circuit for wire spark chambers and an interface for the PDP-5 or PDP-8 computer was constructed. The system has been successfully used for a polarization measurement of the coherent bremsstrahlung. Recently, a CAMAC system of read-out circuits for wire spark chambers and for multiwire proportional chambers was designed. The system will be useful to experiments with the INS electron synchrotron as well as to ones with the future 8 GeV machine. (auth)

33263 (KURRI-TR-115, pp 20-21) THE DEVELOPMENT OF RADIATION DETECTORS. Endo, I. 1973. (In Japanese).

From study meeting on radiation measuring instruments; Kumatori, Osaka, Japan (9 Dec 1972).

In proceedings of the study meeting on radiation measuring instruments.

In line with the policy of further developing established techniques, it was intended to improve the system of the vidicon and spark chamber. The idea is to read on-line the spark coordinates in an ordinary spark chamber with a television camera. An image-taking tube is a vidicon; photo-images memorized on photoconductors are read with an electron beam. With the vidicon placed suitably against the spark chamber, the clear pulses correspondent to spark positions can be observed. The position resolution is 2 to 3 mm/1m, and with a high-performance vidicon tube, 0.8 mm/1m is possible. The system may be applicable to experiments requiring a large number of chamber plates and low counting rate. (JA)

33264 (LBL-3343) SPARK CHAMBER NEUTRON AND PROTON SPECTROMETER: FIRST REPORT ON PERFORMANCES. Mamont-Ciesla, K.; Rindi, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 17 Dec 1974. Contract W-7405-eng-48. 15p. Dep. NTIS $4.00.

An instrument has been built to measure neutron and proton spectra in the energy range between about 30 and 300 MeV to be used in fields as low as about 0.1 particle $cm^{-2}\ s^{-1}$. The

checks and improvements of some of the unfolding computer programs, on the measurements performed in a proton beam and in a neutron beam at the 184-inch Synchrocyclotron, and on some measurements of stray proton spectra behind the shielding of the accelerator are reported. The improvements that are needed for a full use of the potentialities of the instrument are discussed. (auth)

33265 (RL-74-070) CRYSTAL PROGRAMMERS' GUIDE. Chapman, W. S.; Bairstow, R.; Hatley, R. (Science Research Council, Chilton (UK). Rutherford Lab.). Sep 1974. 105p. Dep. NTIS (US Sales Only) $8.25.

The report provides a programmers' working manual for the approximately 25,000 lines of PDP-8 assembler coding used by the CRYSTAL film measurement system in the Bubble Chamber Research Group. (auth)

33266 MEASURING PROJECTOR FOR ANALYSES OF BUBBLE-CHAMBER FILMS. Yamashita, S.; Matsuki, S.; Miyatake, Y. (Nara Women's Univ. (Japan). Dept. of Physics). Bull. Inst. Chem. Res., Kyoto Univ.; 52: No. 1, 58-62(Jul 1974).

Three measuring projectors were constructed for the analysis of the bubble-chamber films. The measurement accuracy obtained was about 10 μm in the scale of the film plane. (auth)

33267 A NEW TYPE OF CATHODE RAY TUBE SUITABLE FOR BUBBLE CHAMBER FILM MEASUREMENTS. Shibata, S.; Soma, T.; Goto, E. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)); Ono, A. (National Lab. for High Energy Physics, Oho, Ibaraki (Japan)). Nucl. Instrum. Methods; 123: No. 3, 431-438(1 Feb 1975).

A newly developed high precision cathode ray tube based on a novel electron-optical system is described. In the tube, a matrix of short focused electron lenses is placed in front of and in parallel to the screen. The incident position and direction of the electron beam to the matrix lens are controlled independently using two sets of deflectors placed between the matrix lens and the electron gun. A tube having better than one part in 12,000 addressing accuracy is achieved by employing an open loop (feedback-free) correction scheme. The spot size is about 25 μm and the effective area is about 60 × 60 mm^2. (auth)

33268 ADVANCES IN A MINIMUM GUIDANCE SYSTEM FOR MEASURING BUBBLE CHAMBER FILM. Davey, P. G.; Harris, J. F.; Hawes, B. M.; Lamb, P. R.; Loken, J. G.; West, N. (Oxford Univ. (UK). Nuclear Physics Lab.). Nucl. Instrum. Methods; 123: No. 3, 445-460(1 Feb 1975).

Hardware and software improvements have been achieved in a CRT film measuring system (PEPR). The use of histogramming techniques with a spot slice scan has greatly improved measuring accuracy, and close tracks can be resolved down to 25 to 30 μm on film. The track follower adaptively uses spot or line element scans according to learned track characteristics and local noise criteria. Very tight checks are applied to fitted track curves and their association with the vertex. Comprehensive operator interaction techniques have been developed for aiding difficult events. For an 11.2 GeV/c π^-p CERN 2 m exposure the single pass efficiency for complete events through track match and geometrical reconstruction has improved from 70% to 90%. The track point and ionization measurements are also greatly improved. Track reconstruction residuals peak at 2.5 to 3 μm on film. (auth)

33269 A SPECTROMETER WITH TIME-COORDINATE COMPENSATION FOR LARGE SCINTILLATORS. Khrenov, A. N.; Rikhvitsky, S. V.; Semenyushkin, I. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). Nucl. Instrum. Methods; 123: No. 3, 471-476(1 Feb 1975).

A spectrometer with a time-coordinate compensator and a 120 × 10 × 10 cm^3 scintillator, used for time-of-flight and coordinate measurements, is described. The accuracy formulae of the spectrometer are presented. In a 4 GeV/c pion beam the space and time-of-flight resolutions are found to be equal to 3.6 cm and 560 ps (fwhm), respectively. (auth)

33270 USE OF A DIRECT NON-PARAMETRIC PATTERN RECOGNITION METHOD FOR THE AUTOMATIC SELECTION OF HIGH ENERGY GAMMA-RAY EVENTS IN SPARK CHAMBER PICTURES. Buccheri, R.; Di Gesu, V.; Salemi, S. (Palermo Univ. (Italy). Istituto di Fisica). Nucl. Instrum. Methods; 123: No. 3, 563-572(1 Feb 1975).

The problem of the automatic selection from background events of electron pairs due to gamma-ray conversion in a multiplate spark chamber is dealt with by means of a direct non-parametric pattern recognition method. The method is applied to the data obtained in a gamma-ray astronomy experiment using a balloon-borne optical spark chamber. A filter operation is initially introduced to exclude clearly evident spurious events; the remaining spark chamber images are then reduced to their most significant zone in order to lower time and cost of subsequent analysis. The feature selection is performed by using a "training set" of labeled events and the classification made introducing a pre-established linear threshold decision function. Results are presented giving the percent of correct classification as a function of the threshold value chosen. (auth)

33271 APPARATUS FOR MEASURING THE PION–TRITON COINCIDENCES INDUCED IN A HELIUM 3 TARGET BY A BREMSSTRAHLUNG BEAM OF 200 TO 500 MeV. Bachelier, D.; Bernas, M.; Bisson, Y.; Boyard, J. L.; Breuil, R.; Hrisoho, A.; Jourdain, J. C.; Lelong, P.; Radvanyi, P. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire). Nucl. Instrum. Methods; 123: No. 2, 217-224(15 Jan 1975). (In French).

An apparatus which has been used to study the $^3He(\gamma,\pi^+)^3H$ reaction around the 3-3 resonance is presented. The beam arrangement and the target are described. A magnetic spectrometer followed by a wire chamber analyzed the momentum of the outgoing pions and defined their emission angle. The tritons emerging from the target are detected in coincidence with the pions by two methods: a telescope of thin plastic scintillators inside the vacuum of the scattering chamber for a triton energy below 40 MeV, or a magnetic spectrometer followed by a series of plastic scintillators for larger energies. (auth)

33272 THE GENERATION OF TRANSITION RADIATION BY RELATIVISTIC PARTICLES IN PLASTIC FOAM RADIATORS. Prince, T. A.; Mueller, D.; Hartmann, G.; Cherry, M. L. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.). Nucl. Instrum. Methods; 123: No. 2, 231-236(15 Jan 1975).

The design of large area transition radiation detectors for highly relativistic particles can be greatly simplified if plastic foam radiators are employed. Using electron beams with energies 1 to 9 GeV at the Cornell synchrotron, the properties of a large variety of transition radiators consisting of commercially available foam materials has been studied. In most cases, a measurable transition radiation signal has been observed, but only a few materials have been found to be suitable for practical purposes. The observed radiation yield is in these cases very similar to that of equivalent multifoil radiators. A detailed discussion is given of the particle detection efficiency that can be obtained with high yield foam radiators. (auth)

33273 SOME OBSERVATIONS CONCERNING THE CONSTRUCTION OF PROPORTIONAL CHAMBERS WITH THICK SENSE WIRES. Brehin, S.; Berger, A. D.; Marel, G.; Tarte, G.; Turlay, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)); Charpak, G.; Sauli, F. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 123: No. 2, 225-229(15 Jan 1975).

In proportional chambers working at atmospheric pressure with sense wires of 100 μm, high amplification in the proportional mode is limited by a special type of discharge: a Geiger pulse of limited extension along the wire of the order of 1 cm with a large local dead time of the order of 0.3 ms. This gives rise to some unpleasant phenomena in large multiwire drift chambers using thick wires but may lead to cheap large detectors for low counting rates. (auth)

33274 EXTERNAL PARTICLE IDENTIFIER (EPI) FOR THE BIG EUROPEAN BUBBLE CHAMBER (BEBC). Aderholz, M.; Lazeyras, P.; Lehrans, I.; Matthewson, R.; Tejessy, W. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 123: No. 2, 237-254(15 Jan 1975).

A description of a multi-layer proportional counter system being built to identify fast charged secondary particles behind the 3.7 m bubble chamber is given in detail. The device consists of 128 layers, each with 32 (6 × 6 cm^2) cells across. It will be able to distinguish pions and kaons up to 70 GeV/c by sampling the ionization in the region of the relativistic rise. (auth)

33275 METHOD FOR SIMULTANEOUS DETERMINATION OF THE DIRECTION AND ENERGY OF RELATIVISTIC COLLIMATED PARTICLES BY MEANS OF VAVILOC–CHERENKOV RADIATION. Zrelov, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR)). Nucl. Instrum. Methods; 123: No. 2, 255-257 (15 Jan 1975).

A method is described which is used for simultaneous determination of the collimated particle motion and their energies by measuring the half-difference and half-sum of the angles at which Vavilov–Cherenkov radiation leaves the plane-parallel radiator. The calculated formulas and the estimates of the method's accuracy are presented. An example of application of this method is given. (auth)

33276 A DOUBLE MAGNETIC SPECTROMETER FOR THE STUDY OF HYPERNUCLEI PRODUCTION BY K^- IN FLIGHT. Bonazzola, G. C.; Bressani, T.; Cester, R.; Chiavassa, E.; Dellacasa, G.; Fainberg, A.; Gallio, M.; Mirfakhrai, N.; Musso, A.; Rinaudo, G. (Turin Univ. (Italy). Istituto di Fisica). Nucl. Instrum. Methods; 123: No. 2, 269-284(15 Jan 1975).

The experimental set-up used to study the production of hypernuclei by the (K^-, π^-) reaction induced by K^- of 390 MeV/c with forward emitted π^- is described. The momenta of the incident K^- and of the emitted π^- were measured by a very compact double magnetic spectrometer, non-focusing, with wide aperture. A single magnet with the target in the middle was used for this purpose. Six pairs of multiwire proportional counters (1700 activated wires) placed in front of, inside and after the magnet were used to measure the trajectories of the particles. Particular care was devoted to the trigger of the experiment and mainly to the separation of K^- from π^- with thin scintillators and threshold Cherenkov counters. A PDP-11/20 on-line computer controlled the experiment. A total energy resolution of 6 MeV (fwhm) on the excitation spectrum of the hypernucleus was obtained. The solid angle for detection of outgoing particles around 0° was of the order of 8×10^{-2} sr. (auth)

33277 PERFORMANCE OF A SPARK CHAMBER AT REDUCED PRESSURE. Bhattacharyya, D. P. (Indian Association for Cultivation of Science, Calcutta); Das, P. K. (Presidency Coll., Calcutta (India)). Nucl. Instrum. Methods; 123: No. 2, 331-332(15 Jan 1975).

A study has been made of the response characteristics of a modular type spark chamber to high energy muons. A detailed analysis of the sparking efficiency of the detector at different gas pressures in the range 160 to 800 mm Hg and at different clearing field intensities and threshold voltages has been made with a time constant of 100 ns, for the two cases when the chamber is filled with neon and with argon. It is found that Paschen's law agrees well for neon and argon when the electrode gap width lies between 0.5 and 2.5 cm. The efficiency of the chamber increases with the increase of the product of pressure and distance between the electrodes. (auth)

33278 SPARK CHAMBER TRACK FINDING PROGRAM. Arens, J. F. (Goddard Space Flight Center, Greenbelt, MD). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 403-409(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

A spark chamber track finding program has been written. The accuracy of the location of the track is good, and if the chamber contains many spurious sparks the computation time is much less than the time used by a least squares fit routine. Multiple tracks can be found and interaction vertices can thereby be determined. (auth)

Radiometric Instruments

33279 (INS-TL-125) ON A BETA PARTICLE THICKNESS GAUGE. Nonaka, I.; Sugai, I. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 30 May 1974. 23p. (In Japanese). INIS.

A beta particle thickness gauge has been developed for the purpose of thickness measurements of target foils for nuclear reaction experiments. The beta ray source was of RaD and the beta ray detector was a SSD which was the same one as the case of the alpha ray thickness gauge developed earlier (INS-J-132, 1971). The values of the absorption coefficients μ/ρ were determined as the functions of the atomic numbers Z of the target foils. The gauge can be used for the measurements of the thicknesses of foils thicker than 10 mg/cm^2 and thinner than about 150 mg/cm^2. (auth)

33280 AN EVALUATION OF ISOTOPIC METHOD FOR DETERMINING THE SURFACE MASS OF A FABRIC, WITH AN IMG-METER, DEPENDING ON ITS FIBER COMPOSITION AND MOISTURE CONTENT. Markiewicz, W.; Misztal, Z.; Malewska, M.; Spodenkiewicz, T.; Wojciechowski, A.; Leonowicz, L.; Mader, K. (Instytut Wlokiennictwa, Lodz (Poland)). Pr. Inst. Wlokien., Lodz; 22: 143-157(1972). (In Polish).

The isotopic method for measuring the surface mass of fabrics by means of IMG-meters was verified in relation to wool, cotton, and blended fabrics, at different relative humidities of the air. The surface mass of fabrics was measured using IMG-meters with scales: 20 to 300 g/m^2 and 50 to 1,100 g/m^2. The measured fabrics had been conditioned at 12%, 65%, and 90% r.h. Evaluation was made of the effect of the raw material and moisture content of the fabrics on the accuracy of the isotopic method with regard to the two measurement scales of the meter. The measurement results are presented graphically. Calibration curves were calculated and raw material tables for reading the surface mass were prepared. It was asserted that meters with the scale 50 to 1,100 g/m^2 are more suitable for determining the surface mass of fabrics. (auth)

33281 REGISTRATING RADIOMETRIC DUST GAGES FOR STATIONARY AND MOBILE USE. Dresia, H. (Essen Univ. (Gesamthochschule) (F. R. Germany)). Tech. Mitt.; 67: No. 11, 473-477(Nov 1974). (In German).

The radiometric dust measurement with β-radiation absorption measurements (^{14}C) is universally applicable in the emission region. The gages mainly operate according to the step filter process where the duration of time of the measured cycle depends on the dust concentration. Removal of gas at the same rate is possible. In order to greatly decrease the measuring errors due to schlieren formation and changes of the flow profile, a revolving removable probe periodically sweeps across the whole flow cross section (for example the chimney cross section). By using a flexible synthetic tube in the drain pipe, the probe length in the chimney is changeable so that measurements can also be carried out according to the VDI regulation 2,066. A measurement of the specific activity in air can easily be combined with the dust emission measurement. (GE)

33282 ERROR IN MEASURING DENSITY WITH A BETA-DENSITOMETER DURING A CHANGE IN ABSORBER COMPOSITION. Starodubtsev, S. V.; Ustinov, I. I. pp 312-323 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

In measuring the density of various liquids and gases by means of radiation, it is necessary to take into account changes in the composition of the medium. A formula was used to estimate the average ionization loss in simple substances as a function of the kinetic energy of a beta particle. It is shown that the ionization loss is directly proportional to the mass density for a two-element absorber. The relative error in measuring the density caused by a change in content of one element was calculated. At a constant density it is possible to calculate the error in measuring the thickness of a material with a change in composition. The densities of 17 mixtures of organic substances were determined with a beta density meter. The hydrogen content of the mixtures varied from 7.7 to 15.8%. The experimental error caused by a change in mass density as a result of a change in hydrogen content was determined and compared with the theoretical value determined by estimating the ionization loss. The two values agreed well with each other. (SJR)

33283 MEASUREMENTS WITH A GAMMA-RAY BACKSCATTERING PROBE FOR USE IN CIVIL AND CHEMICAL ENGINEERING. Dudzus, T.; Segebade, C. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany). Fachgruppe Kerntechnik und Strahlenschutz). Materialpruefung; 16: No. 12, 386(Dec 1974). (In German).

A ^{192}Ir-backscattering probe is briefly described. It is intended to be used for the localization of a steel girder in an industrial building and as a level indicator in a non-transparent plastic water container. (GE)

33284 MODIFICATION OF THE PRODUCTION WELL LOGGING UNIT IN THE RRShA-1 SYSTEM. Medvedev, Yu. S.; Orlov, V. N. (Nauchno-Proizvodstvennoe Obedinenie, Leningrad, Geofizika, USSR) Geofiz. App., No. 53, 116-118(1973). (In Russian).

In the commercial equipment RRShA-1 a proposal is made to replace the probe unit and to change the circuit so that proportional counters can be used as gamma detectors. With modernization of the equipment it is possible to determine by an x-ray radiometric method the light elements (Z = 25 to 40) from the K-series and the heavy elements (Z > 70) from the L-series characteristic radiation in ores. (tr-auth)

33285 THE PRKS-2 LOG RADIOMETER IN DIFFERENT TECHNIQUES OF NUCLEAR LOGGING. Vakhtin, B. S.; Ivanov, V. S.; Novoselov, A. V.; Filippov, E. M. (AN SSSR, Novosibirsk. Inst. Geologii i Geofiziki). Izotopy SSSR; No. 33, 36-39(1973). (In Russian).

It is shown that the borehole survey radiometer PRKS-2 besides measuring the natural radioactivity of ores can be used to carry out other types of surveying by means of an additional probe unit. The radiometer was used in production and exploratory wells to carry out gamma, n-gamma, n-n and n-n (resonance) surveys. The carrying out of a number of types of surveys makes it possible to investigate in greater detail sections of the well and to incorporate the PRKS-2 unit more widely in production. (tr-auth)

33286 ELECTRON CAPTURE DETECTORS. Lovelock, J. E. US Patent 3,870,888. 11 Mar 1975. Priority date 8 May 1971, United Kingdom of Great Britain and Northern Ireland. 4p.

The invention relates to an electron capture detector having an ionization chamber of large volume and into which a sample flows at a high flow rate, the terms "large" and "high" being relative to the hitherto accepted standards for electron capture detectors. Conveniently the ionization chamber can be in the form of an elongated tube having a length which is an order of magnitude greater than any lateral dimension. (Official Gazette)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 34075, 35238, and 35250.

33287 (AD/A-001625) PERMANENT IONIZING RADIATION EFFECTS IN DIELECTRICALLY BOUNDED FIELD EFFECT TRANSISTORS. Neamen, D.; Shedd, W.; Buchanan, B. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). Oct 1974. 10p. (AFCRL-TR-74-0515). NTIS $3.25.

The permanent ionizing radiation effects resulting from the use of dielectrics to bound FET structures have been experimentally determined for a total ionizing dose up to 10^8 rads (Si) and for various dielectric isolation techniques. The experimental vehicles used for making these determinations were dielectrically isolated JFET's operated in such a manner that they behaved as a combination junction-MOS field-effect transistor. The experimental results observed by measuring the saturation current, turn-off voltage, maximum transconductance, and channel conductance of the junction FET show a non-monotonic relationship in the effects of a positive charge build-up in the silicon dioxide isolation dielectric with increasing dose. A theoretical model is derived for calculating the interface charge density as a function of the measurable JFET device parameters. (GRA)

33288 (AD/A-001626) PERMANENT IONIZING RADIATION EFFECTS IN GATE AND ISOLATION DIELECTRICS IN FETs. Neamen, D. A.; Shedd, W. M.; Buchanan, B. L. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 16 Oct 1974. 4p. (AFCRL-TR-74-0513). NTIS $3.25.

The permanent ionizing radiation effects resulting from the use of dielectrics (including sapphire) to bound FET structures have been experimentally determined for a total ionizing dose up to 10^8 rads (Si). Radiation-induced positive charge trapping occurs in the isolation dielectrics which cause leakage currents to flow in n-channel enhancement mode MOSFET's fabricated in SOS. Experimental junction FET's were fabricated so that the effect of the radiation-induced charge trapping in the isolation dielectrics could be determined by measuring the JFET parameters. (GRA)

33289 (AD/A-001627) RADIATION HARDENED CMOS. Buchanan, B.; Shedd, W.; Neamen, D. A.; Roosild, S. A. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 16 Oct 1974. 5p. (AFCRL-TR-74-0514). NTIS $3.25.

The status and methods of qualifying radiation hardened CMOS on bulk and on SOS is presented and the remaining hardening problems, such as radiation-induced photoconductivity in the sapphire substrate, are put in perspective. In addition to new radiation effects data on numerous hardened gate insulators, new radiation effects and problem areas relating to gate electrodes and substrate dielectrics are presented. (GRA)

33290 (GTR-9) IRRADIATION TEST, PRELIMINARY REPORT. (General Dynamics/Fort Worth, Tex. (USA)). 21 Oct 1963. 93p. Dep. NTIS $7.75.

A nuclear experiment, using the Ground Test Reactor (GTR) at the General Dynamics/Fort Worth Nuclear Aerospace Research Facility (GD/FW, NARF), was performed to determine radiation effects on various components proposed for use in the NERVA engine. All the components were tested in two environments (nuclear and cryogenic); however two groups of components were tested in three environments (nuclear, cryogenic, and vibration). Liquid nitrogen was used to provide the cryogenic environment. The experiment was performed in two parts: an extended irradiation at 3-MW with data taken periodically during this period; and testing in two phases, i.e., with power level steps in the beginning of the test with data taken at 0.01 MW, 0.1-MW, 1.0-MW, and 3.0-MW and with an extended irradiation at 3-MW with data taken periodically during this interval. The duration of the experiment was a total of 300-MW. The results of the test are described. (auth)

33291 (GTR-10) NERVA COMPONENTS IRRADIATION PROGRAM, PRELIMINARY REPORT. Evans, J. W.; McMillan, W. D. Jr.; Walton, M. B. (General Dynamics/Fort Worth, Tex. (USA)). 24 Oct 1963. 95p. Dep. NTIS $7.75.

Reactor irradiation tests on NERVA components including pressure transducers, accelerometers, systems amplifiers, and a turbine power control valve actuator are reported. (LCL)

33292 REACTOR TEMPERATURE MEASUREMENTS AND THE REACTOR RADIATION EFFECTS ON TEMPERATURE SENSORS. Chapter 10. Shimanskaya, N. S. pp 280-301 of Ionizing Radiation Calorimetry. Moscow; Atomizdat (1973). (In Russian).

This chapter of the monograph considers the specifics of temperature measurements in a reactor. A short review is given of thermocouples used in reactors and of the results of investigating and developing high-temperature (2500-3000°C) thermocouples for measurements within a reactor. Consideration is given to the effect of reactor radiation on thermocouples, resistance thermometers and thermistors. (tr-SJR).

33293 DEVELOPMENT OF ANTIRADS COAXIAL CABLE FOR AN ATOMIC POWER PLANT. Fukuda, T.; Fujimura, S.; Nagai, H.; Igarashi, Y.; Watanabe, Y. (Furukawa Electric Co. Ltd., Tokyo (Japan)). Furukawa Denko Jiho; No. 55, 35-44 (Feb 1974). (In Japanese).

RG 59 B/u-equivalent coaxial cables, the cables for the compensated ion chambers for output level measurement as the main component of power reactor instrumentation, require additional radiation resistance. Though the cables insulated with inorganic material have been used to date in places subjected to radiation exposure, they have a fatal draw-back of non-flexibility. A polymer is required to be used according to MIL-standard, but is generally degraded by collapse if it is irradiated. Considering also the characteristics other than those mentioned above, it has been decided to mix a radiation protection agent to polyethylene. Phenol families have been concluded effective as the agent. The cable produced for trial on the basis of the requirements of JPDR, JAERI, has been tested together with equivalent domestic and imported cables commercially available. Electrical, chemical and mechanical performances have been measured by irradiating them with a ^{60}Co irradiation equipment, a Linac and a reactor. In the overall evaluation of the results, the cable for trial has been apparently better, especially in insulation resistance, than others, though they all were not able to meet the requirements of JAERI. (JA)

33294 RAPID ANNEALING AND CHARGE INJECTION IN Al_2O_3 MIS CAPACITORS. McLean, F. B.; Boesch, H. E. Jr.; Winokur, P. S.; McGarrity, J. M.; Oswald, R. B. Jr. (Harry Diamond Lab., Washington, DC). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 47-55(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Rapid annealing after radiation and field injection characteristics of Al_2O_3 MIS capacitors have been investigated by means of a fast C-V measurement technique. The results indicate that electron injection under positive bias and trapping of radiation-generated holes are dominated by an interface transition region at the Si-Al_2O_3 interface which need not extend further than 20 to 30 Å from the Si substrate to account for the observations. The field injection charging characteristics are well described by a model invoking direct tunneling of electrons from the Si valence band into electron traps in the interface transition region with an energy distribution consistent with field-injected photo-depopulation studies. (auth)

33295 PERMANENT AND TRANSIENT RADIATION INDUCED LOSSES IN OPTICAL FIBERS. Evans, B. D.; Sigel, G. H. Jr. (Naval Research Lab., Washington, DC). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 113-118(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

With the deployment of fiber optic data transmission links in military and domestic communications systems which may be subjected to various levels of ionizing radiation it is of interest to determine both the permanent and transient radiation-induced optical transmission loss in both fibers and relevant bulk glasses. Loss produced by both ^{60}Co γ-irradiation and by pulsed electron (0.5 MeV) irradiation in both high-loss and low-loss fibers is presented. Luminescence for some hundreds of microseconds following pulsed electron irradiation of low-loss fibers is briefly discussed in terms of possible electromagnetic interference effects. (auth)

33296 CHARGE INJECTION AND TRAPPING IN Al_2O_3 GATE INSULATORS. Powell, R. J.; Hughes, G. W. (RCA Labs., Princeton, NJ). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 179-185 (Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Previous efforts to effectively investigate and model the high-field charging phenomenon in pyrolytic Al_2O_3 have been thwarted by the difficulty of separating the injection and trapping phenomena. Characterizing the injection is extremely difficult because the interface electric field varies as charge accumulates in traps, and the varying field produces rapidly varying currents, making it equally difficult to ascertain trapping behavior. In this work high-field electron injection and photoinjection into Al_2O_3 are investigated using new experimental techniques which maintain constant the interface fields and injection currents, thereby permitting independent determination of injection and trapping char-

acteristics. It is shown that the electron trapping in Al_2O_3 MIS structures is strongly localized near the Si-Al_2O_3 and metal-Al_2O_3 interface regions. Comparisons of electron injection from the metal and from silicon show that the hypothetical native SiO_2 layer at the Si-Al_2O_3 interface either is nonexistent or has no appreciable effect on injection properties. Studies of field and temperature dependence provide evidence that the electron injection occurs by trap-assisted tunneling. (auth)

33297 GAMMA RAY INDUCED CHARGE BUILDUP IN INSULATORS. Kronenberg, S.; Lux, R.; Nilson, K.; Jurczyk, G.; Pfeffer, R.; Berkowitz, H. (Army Electronics Command, Fort Monmouth, NJ). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 243-248 (Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Irradiation of an insulator by gamma rays can produce voltage and charge buildups near thin layers of foreign material within the insulator. Measurements have been made of the current produced as a function of atomic number and thickness of the perturbing layer. Current was also measured as a function of separation from the perturbation, as was voltage buildup within the insulator close to the perturbation. (auth)

33298 HIGH RESOLUTION MEASUREMENTS OF SPACE RADIATION EFFECTS ON SILICON SURFACE-BARRIER DETECTORS. Reagan, J. B.; Matthews, J. D.; Kilner, J. R.; Bakke, J. C.; Imhof, W. L. (Lockheed Palo Alto Research Lab., Palo Alto, CA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 373-377(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Two high-resolution charged particle spectrometers employing silicon surface-barrier detectors have been operated in an 800 km altitude polar orbit for a 26-month period between October 1971 and December 1973. Based on existing trapped radiation models and the measured solar flare environment during this period the detectors were exposed to a proton fluence of 2.8×10^{10} protons/cm^2 at energies >400 keV and an electron fluence of 4.5×10^{12} electrons/cm^2 at energies >50 keV. High-resolution pulse height spectra of the alpha particles from low-intensity Americium-241 in-flight calibration sources show that the resolutions of the detectors did not degrade more than 5 percent and that the gains of the system did not vary more than 1.2 percent as a result of this exposure. Two aspects of detector operation are considered responsible for this performance. First, the incident detectors were operated with the rear, aluminum contact exposed to the radiation environment instead of the front, gold contact. The more intense lower energy radiation is therefore stopped in the rear ohmic contact region instead of in the front surface-barrier junction region and the overall damage effects are significantly reduced. Second, a detector bias technique was employed that automatically maintained a constant depletion potential across the detector independent of variations in leakage current due to radiation damage. (auth)

33299 FAST NEUTRON IRRADIATION DAMAGE ON ROOM TEMPERATURE PbS DETECTORS. Molnar, B. (Naval Research Lab., Washington, DC). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 103-106(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

The effects of high-energy neutron irradiation on the photoconductive properties of chemically-deposited PbS infrared detectors have been investigated in the 10^{11} n/cm^2 to 10^{14} n/cm^2 fluence range. Long term degradation in signal response has been observed subsequent to room temperature irradiation of 2×10^{12} n/cm^2 or greater fluences. Seventy-five percent of the degradation can be attributed to a reduction in majority carrier lifetime, and the most likely source for the additional 25% reduction in the photoconductivity is the quantum efficiency. However, the degradation is not permanent. The recovery proceeds logarithmically with time. The dark resistance was unaffected by the irradiation. Additionally, if the detector views a visible light source simultaneously with the neutron irradiation, a significant increase in signal degradation rate is found. (auth)

33300 RADIATION INDUCED MOBILITY CHANGES IN BUBBLE-DOMAIN MATERIALS. Wilsey, N. D.; Lessoff, H. (Naval Research Lab., Washington, DC). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 138-140(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Domain wall mobility changes have been observed in magnetic bubble domain materials (rare-earth iron garnet films) following irradiation with 3 MeV protons to fluences of 5×10^{16} p/cm^2 and 10^{17} p/cm^2. The mobility was observed to decrease by 24% and 43%, respectively. No measurable changes in the coercive field have been observed. Similar experiments with 1 MeV electrons to 10^{15} e/cm^2 and 14 MeV neutrons to 10^{14} n/cm^2 have yielded negative results. A damage threshold of $\sim 10^{16}$ p·cm^2 at 3 MeV is established and a fast neutron damage threshold is inferred to be $\sim 10^{13}$ n/cm^2. A slight broadening of the ferromagnetic resonance linewidth following the proton irradiations is evidence of increased magnetic damping caused by displacement damage in the garnet films. (auth)

33301 LUMPED-ELEMENT MODELING OF SATELLITE SGEMP EXCITATION. Wenaas, E. P. (Intelcom Rad Tech, San Diego, CA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 271-275(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

A technique utilizing a lumped-element approach was developed for modeling the SGEMP response of a satellite-like structure. The space outside the structure is modeled by a number of current generators representing the real current produced by emitted electron charge, and capacitors are used to model the displacement current. Numerical solutions are obtained for a single electron moving away from a sphere, and compared with more exact solutions utilizing the Maxwell equations directly. (auth)

33302 STORED CHARGE IN TANTALUM CAPACITORS: LATENT AND MANIFEST MAVERICKS. Flanagan, T. M.; Leadon, R. E.; Colwell, J. F.; Berger, R. A. (Intelcom Rad Tech, San Diego, CA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 378-382(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Relatively permanent space-charge fields can be established in Ta-Ta_2O_5-MnO_2 capacitor structures by any of the following: 1) ionizing radiation with forward bias (tantalum electrode positive); 2) reverse bias without radiation; and 3) forward bias without radiation. All of the capacitors store charge by the first two mechanisms. Only when a permanent space-charge polarization field can be established by condition 3 can the unit be called a "maverick." The polarization behavior arises due to nonuniform trapping of charge in the oxide. In a normal capacitor, the polarization under irradiation occurs when the ionized electrons and holes are separated by the electric field in the oxide. Since the time and radiation history of the charge release in a maverick is similar to the charge release in a polarized normal capacitor, mavericks are apparently capacitors that can become polarized in the absence of radiation--for example, just due to an applied bias. This model has been simulated with the computer code PN, and the characteristics of the experimental data are reproduced. A maverick capacitor can be either latent or manifest, and a simple test for the zero-bias radiation response will not necessarily reveal a maverick unless a space-charge field has previously been established. These results are used to suggest tests to eliminate mavericks from the population. (auth)

33303 USE OF A SCANNING ELECTRON MICROSCOPE FOR SCREENING BIPOLAR SURFACE EFFECTS. Lipman, J. A. (Texas Instruments Inc., Dallas); Bruncke, W. C.; Crosthwait, D. L.; Galloway, K. F.; Pease, R. L. IEEE Trans. Nucl. Sci.; NS-21: No. 6, 383-386(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

A method of screening bipolar transistors for total dose surface effects using a scanning electron microscope (SEM) is described. This screening technique is implemented by irradiation of a selected pattern of dice on each wafer. The electron-induced damage from the SEM is shown to correlate with equivalent total dose irradiations from a ^{60}Co source. It is also shown that the degradation of the selected dice is characteristic of the remaining dice on the wafer. (auth)

33304 SEM IRRADIATION FOR HARDNESS ASSURANCE SCREENING AND PROCESS DEFINITION. Cohen, S. (RCA Solid State Tech. Center, Somerville, NJ); Hughes, H. IEEE Trans. Nucl. Sci.; NS-21: No. 6, 387-389(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Low-energy electron irradiation of complementary metal-oxide semiconductor (CMOS) devices has been correlated to cobalt-60 gamma irradiation in terms of oxide space charges and interface states. This paper reports on the results obtained using the low-energy electron beam of a standard commercial scanning-electron-microscope (SEM) for in-process hardness assurance screening and as a tool for rapid evaluation of process variations designed to improve total-dose radiation hardness. The techniques for SEM testing are described, and the results of correlation studies of radiation effects produced by the SEM, gamma radiation (Co-60), and 10^4-eV sources compared. The variance in total dose

radiation hardness over a single wafer and from wafer to wafer has been investigated for the CMOS CD-4007 array and the results are reported. (auth)

33305 HARDNESS ASSURANCE IN QUARTZ CRYSTAL RESONATORS. Flanagan, T. M. (Intelcom Rad Tech, San Diego, CA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 390-392(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Methods are discussed for hardness assurance qualification screens for quartz crystal resonant devices. Verifying that the quartz bar has been properly swept and ensuring device traceability to that bar may be adequate for filter applications and some oscillators. For precision resonators, the radiation testing of each resonator is the only known way to be certain that a defective resonator was not obtained. Recommendations for particular tests are given. (auth)

33306 NEUTRON HARDNESS ASSURANCE TECHNIQUES FOR TTL INTEGRATED CIRCUITS. Johnston, A. H.; Skavland, R. L. (Boeing Aerospace Co., Seattle). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 393-398(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Correlation and screening techniques for neutron degradation of TTL integrated circuits have been examined at three different levels: measurements restricted to normal electrical leads, measurements using special internal leads, and measurements with a special chip level breakout transistor. The results of this study show much higher prediction accuracies for neutron degradation when the special lead or breakout transistor measurements are used. The special lead approach can be implemented with DC measurements, and it is feasible to make these measurements at the wafer probe level to eliminate the necessity of changing the pinout on the packaged device. These special leads can be added to radiation-hardened circuits to optimize their application to high reliability systems. (auth)

33307 ANALYTICAL MODELING AND EXPERIMENTAL TESTING OF PRESSURE EFFECTS IN SMALL CAVITIES COUPLED TO CIRCUITRY. dePlomb, E. P. (Intelcom Rad Tech, San Diego, CA); Fitzwilson, R.; Beemer, P. IEEE Trans. Nucl. Sci.; NS-21: No. 6, 302-307(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Photo-emission currents and their associated electromagnetic fields are generated when photons irradiate any system. When gas-filled cavities are irradiated, photo-ionization and collisional ionization of the gas can produce a background plasma which significantly alters the electromagnetic response within the cavity. Previous studies have concentrated on conditions within an irradiated cavity; in this paper the modifications of circuit response caused by x-ray energy photons incident upon a small gas-filled cavity which is an element of an electrical circuit are considered. Such a configuration is present in various practical devices. Experiments were performed with the dense plasma focus (DPF) x-ray simulator at Aerospace Corp., in which a planar-geometry device containing gas in a thin interior space was coupled to an external circuit. An original analytical method was developed that replaces the irradiated gas-filled cavity with a current source shunted by a load. Under certain conditions that commonly occur in such circuit analysis, a time-averaged plasma resistance in parallel with a capacitance may be used to shunt the current source. Analytical predictions were found to compare favorably with the measured circuit current. Cases are presented for different values of gas pressure, circuit parameters, type of gas used, and photon pulse-time history. (auth)

33308 MSI/LSI RADIATION RESPONSE, CHARACTERIZATION AND TESTING. Raymond, J. P. (Northrop Research and Tech. Center, Hawthorne, CA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 308-314(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Results are presented on the permanent damage and transient photoresponse of complex monolithic MSI/LSI arrays representing a variety of both bipolar and MOS technologies. Unique aspects of MSI/LSI vulnerability are principally in the nature of the basic logic cells and the complexities of overall array performance evaluation. Considerations illustrated in permanent damage evaluation are complete performance evaluation, electrical bias conditions during radiation exposure, selection of sample sizes, and electrical pulse overstress effects. Considerations illustrated in the transient photoresponse are the dependence on ionizing radiation pulse-width, determination of worst-case logic operating conditions, and power-supply photocurrent. Analytical techniques are suggested as an essential aid in MSI/LSI characterization and testing. (auth)

33309 EFFECTS OF IONIZING RADIATION ON DIFFUSED RESISTORS. Fossum, J. G.; Sander, H. H.; Gerwin, H. J. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 315-322(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

A theoretical examination of the effects of ionizing radiation on diffused resistors performed to ascertain the feasibility of their use in hardened dielectrically isolated integrated circuits is described. The two basic effects—conductivity modulation, which is generally insignificant or can easily be rendered so, and photocurrent generation, the consequences of which essentially determine the diffused resistor hardness—are studied. Results indicate that typical dielectrically isolated diffused resistors are quite invulnerable to ionizing radiation. Design guidelines to achieve optimum hardness are implied. Initial findings of radiation experiments performed on a diffused resistor test chip are reported. When transient leakage dissociated with the resistor structures is accounted for, the results substantiate the primary conclusions of the theoretical study. (auth)

33310 INTEGRATED CIRCUIT MODEL DEVELOPMENT FOR EMP. Kleiner, C.; Nelson, J.; Vassallo, F.; Heaton, E. (Rockwell International Autonetic, Anaheim, CA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 323-331(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

The response of Integrated Circuits (IC) to pulsed and gated sine-wave stimuli can be used to develop reasonably accurate device models for EMP assessment. These IC models can then be used in conjunction with circuit and transfer function models to determine the failure threshold (upset and burnout) to postulated EMP disturbance. This paper describes the model development and test verification of IC models representing the following technologies: 1) Junction Isolated Devices: Eight TTL devices including gates, comparators, inverters and Flip-Flops; and 2) Dielectrically Isolated Devices: Nine DTL and two TTL devices including gates, input and output networks, level detectors and Flip-Flops. All devices were modeled and tested for upset over a frequency range from 10 kHz to 50 MHz. Input voltage amplitudes ranged from 0.5 to 50 volts with source impedances tailored to device configurations resulting from EMP systems analysis. For upset, correspondence between model prediction and test verification was observed to be within ± 3 db (referenced to the test level) from 10 kHz through 20 MHz. (WHK)

33311 EMP HARDENED CMOS CIRCUITS. Stewart, R. G.; Hampel, D. (RCA, Somerville, NJ). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 332-339(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

This paper shows how CMOS integrated circuits can be protected against electrical transients originating from nuclear explosions, static discharge, etc. First, the causes of transient failures are determined and then analyzed. Next, a wide range of protection devices are designed and evaluated. Finally, complete transient hardened logic gates are fabricated and tested to prove the feasibility of EMP hardened CMOS circuits. (auth)

33312 COMPUTER-AIDED VULNERABILITY ANALYSIS OF A DIGITAL-TO-ANALOG CONVERTER. Pocock, D. N. (Northrop Research and Tech. Center, Hawthorne, CA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 340-347(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Results are presented on the application of previously developed simplified microcircuit modeling techniques to the analysis of an existing military subsystem in order to identify problem areas and demonstrate the state of the art. The D/A converter subsystem studied is part of the flight instrumentation used in the E4A (military version of 747) aircraft. It contains both digital and analog microcircuits, monolithic and hybrid, as well as discrete bipolar transistors and passive elements. The overall problem approach was that of an engineering vulnerability analysis on the subsystem. The individual components were experimentally characterized and modeled, and the component models were then interconnected to obtain a simulation of the entire D/A converter using an expanded version of the MINI-SCEPTRE computer code. Comparison of computer predictions and experimental data demonstrates reasonably good agreement to within the repeatability of component samples. The major problem is the long computer run time and associated cost for a single photoresponse prediction. (auth)

33313 MEASUREMENT AND PREDICTION TECHNIQUES FOR DC TO DC CONVERTER FAILURE MODES. Tanke, J. M.; Conn, J. M.; Monte, S. J. (Martin Marietta Aerospace, Orlando, FL). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 348-352(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Dc to dc converter circuits in an ionizing environment are vulnerable to two common failure modes: overcurrent and second breakdown. This paper presents a study of these failure modes using a combination of laboratory tests, computer simulations, and super flash X-ray (SFXR) tests. Special techniques were used to measure a single load line transition in an actual SFXR environment and to predict these critical operating conditions using a widely distributed circuit analysis computer code. The results of the laboratory electrical tests, digital computer simulations, and SFXR tests were in good agreement, placing confidence in the ability to simulate, measure, and predict the failure modes associated with this type of dc to dc converter in an SFXR environment. (auth)

33314 COMPUTER SIMULATION OF RADIATION INDUCED EMITTER CROWDING. McEwan, J. R. (Bell Telephone Labs., Inc., Murray Hill, NJ). IEEE Trans. Nucl. Sci., NS-21: No. 6, 353-358(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Radiation induced emitter crowding effects can precipitate an anomalous photocurrent response. Such a response would not be predicted by the usual computer simulation using a charge control representation of a bipolar transistor equipped with a primary photocurrent source. Radiation induced emitter crowding effects are prevalent in large epitaxial power transistors which operate with low impedance loads where large photocurrents are observed as a result of irradiation. A model has been developed which simulates radiation induced emitter crowding and it is applicable to most existing circuit analysis codes. Experimental data obtained from pulsing 50 watt silicon epitaxial power transistors with 50 nanosecond and 8 microsecond linear accelerator pulses in the electron beam mode show excellent agreement with the predicted results. (auth)

33315 RADIATION INDUCED CURRENTS IN SHIELDED MULTI-CONDUCTOR AND SEMIRIGID CABLES. Fitzwilson, R. L. (Aerospace Corp., El Segundo, CA); Bernstein, M. J.; Alston, T. E. IEEE Trans. Nucl. Sci., NS-21: No. 6, 276-283 (Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

We report the results of a study of replacement currents generated in multiconductor and semirigid coaxial cables during irradiation by low (20 to 100 keV) photons. Short samples (~ 5 cm) of each of thirteen cable types were exposed to filtered radiation from a plasma focus device and the induced center conductor currents were measured for vacuum and air environments. Vacuum responses could be correlated with the magnitude and location of small gaps between the cable elements and the dielectric material, while air responses depended on prior irradiation history, cable geometry, and applied center conductor bias potentials. An analytic computer code has been developed to evaluate the radiation response of these complex cables for a vacuum. Cable air responses are qualitatively discussed in terms of ionized gas kinetics. (auth)

33316 STUDY OF IEMP EFFECTS ON IC OPERATIONAL AMPLIFIER CIRCUITS. Bernstein, M. J.; Paschen, K. W. (Aerospace Corp., El Segundo, CA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 284-290(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Three typical operational amplifiers were irradiated by a plasma focus to study their IEMP responses with and without superposition of TREE responses. The 30-kJ plasma focus device produced photons primarily in the 8 to 100 keV range with pulse widths typically in the range of 10 to 15 nsec. Pulses of electrons were also deposited on the external leads of the op amps to determine the characteristic responses. These units were operated in circuits with closed-loop gains ranging from 5 to 100. During direct irradiation of the op amps, it was found that the IEMP responses (caused by photoemission within the housings) dominated the TREE responses provided that the RC time for the deposited charge to drain to ground was longer than a characteristic op amp response time. The gas normally contained inside hermetically-sealed op amp units enhanced their IEMP responses. For most op amps, charge deposited on the input leads dominated the response, but some types were also sensitive to charge deposited on other external leads such as those controlling the offset. (auth)

33317 RADIATION INDUCED REPLACEMENT CURRENTS IN A PLATED WIRE MEMORY. Fitzwilson, R. L.; Comisar, G. G. (Aerospace Corp., El Segundo, CA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 295-301(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

The results of a study of the replacement currents generated in elements of a conventional plated-wire memory during irradiation by low energy (20 to 100 keV) photons are reported. Measurements are analytically discussed in terms of IEMP induced-charge calculations and, for an air environment, ionized gas kinetics. It is experimentally demonstrated that the peak induced digit wire currents (per unit flux) can be reduced by at least a factor of 10 when the memory tunnel structure is filled with a dielectric oil. (auth)

33318 INTERACTION OF NUCLEAR ENVIRONMENT WITH MNOS MEMORY DEVICE. Brucker, G. J. (RCA Astro Electronics Div., Princeton, NJ). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 186-192(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

This paper reports on the results of an investigation of the interaction of a nuclear environment with a metal-gate, silicon nitride, silicon dioxide, silicon-on-sapphire memory device. The test device was a 63-bit (7 words by 9 bits) three-terminal device. The tests were as follows: (1) transient photocurrent, (2) transient annealing, (3) total dose, (4) survivability, and (5) neutron tests. Facilities at AFCRL were used in the first four tests and at the Aberdeen Pulse Reactor for the last test. Samples were irradiated under power. Both interrogated and passive words containing "1" and "0" states were investigated. Transient photocurrent and annealing data were obtained with the Linac operating in the electron mode. Electron energy was 10 MeV and pulse widths of 20 nanoseconds and 4.5 microseconds were used. Total dose data was obtained with a cobalt-60 source as well as the reactor. A Flash X-ray generator operating in the electron mode (20-nanosecond pulse) was used to determine survivability rates. (auth)

33319 EFFECTS OF IONIZING RADIATION ON CHARGE-COUPLED DEVICE STRUCTURES. Killiany, J. M.; Baker, W. D.; Saks, N. S.; Barbe, D. F. (Naval Research Lab., Washington, DC). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 193-200(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

The effects of ionizing radiation on four different charge-coupled device structures have been investigated. Both shift registers and optical imaging devices have been considered. The electrical and imaging (where appropriate) performance of the devices were evaluated as a function of total gamma ray dose. The principal failure mechanisms have been identified for each particular device structure. Some conclusions about the relative radiation tolerance of the various device designs are drawn. (auth)

33320 TRANSIENT AND STEADY-STATE RADIATION RESPONSE OF CMOS/SOS DEVICES. Brucker, G. J. (RCA Astro Electronics Div., Princeton, NJ). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 201-207(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

In an investigation to characterize the radiation properties of a pilot line product capability for manufacture of MNOS memory arrays, a CMOS test vehicle proposed as the building block for the array electronics was tested in a nuclear environment. The test device was a CD4007 configuration fabricated with an unhardened SiO_2 gate insulator on a sapphire substrate. Test devices were made with aluminum and silicon gates, and test samples were selected to satisfy the requirement of operating satisfactorily with a source-drain voltage ≤21.5 volts. All tests were conducted with a drain-source voltage of 20 volts and gate biases in the range of 0 to 20 volts. The tests were as follows: (1) transient photo-current, (2) transient annealing, (3) total dose, (4) survivability, and (5) neutrons. Facilities at AFCRL were used for the first four and the Aberdeen Pulse Reactor for the last test. The tests were conducted in the order listed above on different batches of samples for each test. (auth)

33321 RADIATION INDUCED LEAKAGE CURRENT IN N-CHANNEL SOS TRANSISTORS. Kjar, R. A.; Peel, J. (Rockwell International, Electronics Research Div., Anaheim, CA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 208-210(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

High drain-leakage currents have been observed in n-channel SOS transistors after exposure to ionizing radiation. These currents could not be explained by the change in gate threshold voltage or by other radiation effects in the gate insulator. Two mechanisms were identified as being responsible for the radiation-induced leakage current. Charge trapping in the sapphire and the consequent formation of a channel at the silicon-sapphire interface is the major cause of the leakage current. Under some conditions, a smaller component of leakage current can also result from charge trapping in the silicon dioxide at island edges. (auth)

33322 RADIATION INDUCED CHARGE TRAPPING AT THE SILICON SAPPHIRE SUBSTRATE INTERFACE. Neamen, D.; Shedd, W.; Buchanan, B. (Air Force Cambridge Research Labs., Bedford, MA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 211-216 (Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

The radiation induced charge trapping at the silicon sapphire interface and its effect on MIS/SOS device performance has been experimentally determined for a total ionizing dose up to 10^5 rads (Si). These effects were determined by measuring the electrical characteristics of three types of device structures fabricated in SOS material: MIS devices with hardened and unhardened gate insulators, JFET's and diodes. The main emphasis is on the use of novel JFET structures for characterizing the SOS interface by modulating the gate depletion region against the sapphire substrate. Micrographs are also presented which show radiation induced changes in the staining characteristics of angle lapped and stained sections of the SOS interface. The experimental results indicate that positive charge is trapped in the sapphire substrate near the silicon-sapphire interface due to the total ionizing radiation. A model of the radiation induced charge trapping at the silicon sapphire interface is proposed. (auth)

33323 SILICON-ON-SAPPHIRE DEVICE PHOTOCONDUCTION PREDICTIONS. Phillips, D. H. (Rockwell International Corp., Anaheim, CA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 217-220 (Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

The linear sapphire photoconductance approximation was used to model dose-rate effects on CMOS/SOS inverters. From this model, optimum values were derived for the ratio of n-channel to p-channel transistor gate width, thereby maximizing the dose-rate failure threshold. (auth)

33324 PERFORMANCE OF $Ga_{1-x}Al_xAs$ LIGHT EMITTING DIODES IN RADIATION ENVIRONMENTS. Polimadei, R. A. (Harry Diamond Labs., Washington, DC); Share, S.; Epstein, A. S.; Lynch, R. J.; Sullivan, D. IEEE Trans. Nucl. Sci.; NS-21: No. 6, 96-102(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Addition of aluminum as a cation substituent in GaAs improves the relative radiation hardness of the GaAs light emitting diode, as deduced from both gamma and neutron irradiation experiments to 10^8 rads (Si) and 3.5×10^{13} neutrons/cm^2, respectively. The gamma damage coefficient, K_γ, shows a marked and unexpected decrease from 52 (rads (Si)$\cdot$s)$^{-1}$ to $\sim$2 (rads (Si)$\cdot$s)$^{-1}$ in the composition range from GaAs to $\sim Ga_{.90}Al_{.10}As$. Above 10 percent Al content, the damage coefficient changes only slightly. On the other hand, the neutron damage coefficient K_n shows a gradual change over the entire compositional range from 0 to 34 percent aluminum. Annealing of the gamma-irradiated samples indicates that the 240°C stage noted for GaAs and attributed to an arsenic vacancy is reduced with addition of aluminum. On the other hand the annealing of the $Ga_{1-x}Al_xAs$ samples following neutron irradiation indicates that the annealing characteristics are virtually independent of the aluminum composition. For both types of irradiation there is a shift of the peak emission wavelength to shorter wavelengths following irradiation. (auth)

33325 IONIZING RADIATION DOSIMETRY AND NOISE IN SMALL GEOMETRY DEVICES. Vickers, V. E.; Shepherd, F. D. Jr.; Burke, E. A. (Air Force Cambridge Research Labs., Bedford, MA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 107-112 (Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

A code is presented to predict the statistics of transient responses to gamma radiation of rectangular solid state devices. Use of the chordlength distribution and assuming the radiation flux isotropic obviates use of Monte Carlo techniques, so that the code runs fast enough for exploratory use. It is discovered that, for small detectors, relatively large-area non-square thin detectors are advantageous. (auth)

33326 TRANSIENT RADIATION RESPONSE OF JFETS AND MISFETS AT CRYOGENIC TEMPERATURES. Long, D. M. (General Electric Co., Philadelphia). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 119-123(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

This paper provides experimental and analytical data on the transient radiation response and d.c. electrical characteristics of JFETs and MISFETs at cryogenic temperatures. Experimental measurements were performed on commercially available silicon devices over the temperature range 4.2°K to 300°K. A 2 MeV Flash X-ray Facility was used for the photocurrent measurements. The theoretical effort provides a compilation of silicon properties at cryogenic temperatures and scopes out the first-order temperature dependence of JFETs and MISFETs. It was observed that (a) the MISFET functioned well at channel temperatures down to 4.2°K, (b) the JFET would not conduct current at channel temperatures below 50°K (though it could be held on by self-heating at case temperatures down to 4.2°K), (c) the photocurrents of each device enhanced by a factor of 2 or more at temperatures below 40°K. The results are in general agreement with first-order theory, but many problems must be resolved to achieve adequate modeling and understanding of relevant phenomena. (auth)

33327 PROPERTIES OF HEAVILY IRRADIATED MOSFETS. Gaw, E. T.; Oldham, W. G. (Univ. of California, Berkeley). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 124-129(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Studies of channel mobility reduction in P channel MOSFETS with gamma and/or neutron irradiation are reported. For pure gamma irradiation, the reduction in mobility is caused by increased surface charge scattering. The surface charge scattering mobility is found to have a temperature and surface charge dependence of $T^{-0.5}/N_{SC}$. For pure neutron irradiation, the reduction in channel mobility arises from scattering at neutron-produced bulk-centers. In reactor neutron irradiations, gamma fluence can be as important as the neutron fluence in reducing channel mobility. (auth)

33328 NUCLEAR RADIATION EFFECTS ON SURFACE ACOUSTIC WAVE DEVICES. Berg, N.; Udelson, B. J. (Harry Diamond Labs., Washington, DC). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 141-148(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

A comprehensive summary of the effects of pulsed ionizing radiation on the operation of several types of passive surface acoustic wave devices is presented. Three distinct types of malfunction were observed and are discussed in detail. In addition, the effects of neutron and ^{60}Co gamma permanent displacement damage on the operation of a monolithic SAW amplifier are presented. (auth)

33329 OPTIMIZED PROFILES FOR NEUTRON AND PHOTOCURRENT HARDENED POWER TRANSISTORS. Clark, L. E.; Saltich, J. L. (Motorola Semiconductor Products Div., Phoenix, AZ). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 149-151(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

This paper discusses two problems: the partitioning of bipolar transistor breakdown voltage between the collector and the base in the context of neutron tolerance, and the dependence of collector photocurrent on substrate doping. It is suggested that enhanced neutron tolerance for a given breakdown voltage may sometimes be achieved by increasing the basewidth so that a portion of the breakdown voltage is supported by the base. Peak current gains of ten were achieved with a four micron basewidth after exposure to 3×10^{14} neutrons (1 MeV eq.) cm^{-2}. Substrate photocurrents were found to be very dependent on substrate doping; by using a substrate doping of 10^{20}cm^{-3}, substrate photocurrents were suppressed to an equivalent silicon photocurrent collection length of three microns. (auth)

33330 RADIATION HARDENING OF CMOS/SOS INTEGRATED CIRCUITS. Schlesier, K. M. (RCA Labs., Princeton, NJ). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 152-158(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Radiation tolerant CMOS circuits can be made by building them in a thin film of silicon-on-sapphire (SOS) with a hard gate dielectric. Radiation effects in MOS devices are reviewed, and the problems associated with radiation tolerant CMOS/SOS devices are described. Some gate dielectric techniques which show promise in hardening CMOS circuits are presented, and the radiation behavior of Al_2O_3 gate dielectrics are described. (auth)

33331 GAMMA AND VACUUM ULTRAVIOLET IRRADIATIONS OF ION IMPLANTED SiO_2 FOR MOS DIELECTRICS. Emms, C. G. (GEC Hirst Research Centre, Wembley, Eng.); Holmes-Siedle, A. G.; Groombridge, I.; Bosnell, J. R. IEEE Trans. Nucl. Sci.; NS-21: No. 6, 159-166(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Electrical measurements are described of grown silicon dioxide thin films irradiated by gamma rays, X-rays and broadband VUV light. The dependence of radiation-sensitivity on processing variations, including annealing temperature, is compared for unimplanted SiO_2 and SiO_2 implanted with aluminium, argon, xenon and

cerium. The flatband voltage shift is suppressed under positive irradiation bias by each of those chemically disparate ions. This finding suggests that the implantation of ions at energies of several kilovolts, with fluences of 10^{14} to 10^{15} cm^{-2}, improves hardness by the production of similar distributions of electron traps with densities of the order of 10^{12} traps cm^{-2} by lattice damage and not by the direct combination of the ion with intrinsic or radiation-induced hole traps. This is supported by observations that the effect anneals out gradually at temperatures between 300°C and 1000°C and that the same traps can be neutralized by injection of photoelectrons into the oxide. It is thus confirmed that ion implantation into the dielectric is a versatile method for producing radiation-tolerance under positive bias in silicon dioxide. A further finding is that broadband VUV light from a H_2 discharge lamp can conveniently and closely simulate the radiation response caused by γ and X-rays in a wide range of dielectrics for MOS devices. (auth)

33332 EFFECTS OF HCl GETTERING, Cr DOPING AND Al^+ IMPLANTATION ON HARDENED SiO_2. Aubuchon, K. G.; Harari, E.; Leong, D. H.; Chang, C. P. (Hughes Aircraft Co., Newport Beach, CA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 167-171(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

It has previously been demonstrated that the growth conditions of thermal SiO_2 can be optimized to give acceptable operating performance for P-MOS devices and circuits after ionizing radiation dose levels of 10^7 rads and above. Further work has since been done to apply this hardening technology to CMOS circuits, with very promising results. Also studied were the effects of adding HCl gettering, chrome doping, and aluminum ion implantation to the hardened SiO_2. Each of these additions, when properly employed, was found to give improved hardening. The nature of these improvements is described along with their applicability to the fabrication of CMOS circuits with improved hardness but which retain all the other advantages of the SiO_2 gate insulator. Since all process variations were performed in the same laboratory under otherwise identical conditions, the results presented represent a true comparison of the various hardening techniques. (auth)

33333 RAPID ANNEALING IN IRRADIATED CMOS TRANSISTORS. Simons, M. (Research Triangle Inst., Research Triangle Park, NC). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 172-178(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Data characterizing the transient annealing of the gate threshold voltage of contemporary CMOS transistors following exposure to pulsed ionizing radiation are presented and discussed. Devices tested during the study include those fabricated on both bulk silicon and silicon-on-sapphire substrates. Silicon dioxide and aluminum oxide gate dielectrics are evaluated. Leakage current phenomena associated with charge formation in dielectric substrates or dielectric isolation layers are also considered. (auth)

Miscellaneous Instruments

Refer also to abstracts 32813, 33469, 33470, 33486, and 35620.

33334 (KIYI-73-14) RECOGNITION OF BAD MEASUREMENTS DURING DATA PROCESSING OF PHYSICS EXPERIMENTS. Bezruk, A. I. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). 1973. 14p. (In Russian). INIS.

The automation of physics experiments often means that data from the measuring devices enters the memory of the computer without preliminary processing. In these cases the computer must reject bad measurements resulting from the lack of reliability of the measuring devices. The purpose of this study is to obtain an algorithm for the determination of bad measurements on the basis of a generalized effective evaluation of the parameters. Some results of tests on the use of the program written in ALGOL-60 using this algorithm are given. (tr-auth)

33335 (LA-5883-PR, pp 103-122) BIOPHYSICS AND INSTRUMENTATION. Feb 1975.

In biomedical and environmental research program of the LASL Health Division. Annual report, January-December 1974.

The research activities of the Biophysics and Instrumentation Group include: development of flow-systems instrumentation for rapid cell analysis and sorting; development of cell staining and preparational techniques suitable for use with flow-systems instruments; biological and medical applications of flow-systems cell analysis and sorting instrumentation; physical dosimetry and radiobiology studies at LAMPF; and electronic computer and other support for the LASL biomedical program. The physical dosimetry and radiobiology studies at LAMPF include: age-response of line CHO cells to x irradiation and α particles from Pu; cell survival curves; cell survival as a function of depth; and response of normal skin (mouse foot) to fractionated doses of x irradiation. (ERB)

33336 (NTIS/PS-74/102) MINICOMPUTERS: A BIBLIOGRAPHY WITH ABSTRACTS. Report for 1964-September 1974. Grooms, D. W. (National Technical Information Service, Springfield, Va. (USA)). Nov 1974. 231p. NTIS $20.00.

This bibliography contains 215 selected abstracts of research reports retrieved using the NTIS on-line search system-NTISEARCH. The report cites research on the vast applications of minicomputers. A few of the areas of application included are audio recorders, chemical analysis, radiation detection, process control, ocean sciences, tracking systems, and production control. The report also contains the supporting software for solving the problems and processing the data in the many areas of application. (GRA)

33337 POSSIBILITIES OF USING COMPUTERS FOR CORRELATING BOREHOLE CROSS-SECTION. Vinitskii, Yu. S.; Solomeshen, K. N.; Khalimov, E. M. Tr. Tyumenskogo Ind. Inst.; No. 16, 58-62(1973). (In Russian).

From proceedings of Tyumen Industrial Inst.; Tyumen, USSR (1973).

The problem of correlating cross-sections was solved for cases when there are reliable reference points and the widths of the boreholes do not vary greatly. The measurements are made in groups based on a complex of relative values of the parameters of well potential, resistance, method, gamma logging, neutron-gamma logging, and others, including the ratio of the distance from the top of the stratum to the thickness of the whole deposit and of the thickness of the stratum to the thickness of the deposit. The problem was solved by minimization of the distance from the objects of the test group of the i-th class to the reference portion of this class, C_i, compared to the distances from the objects of the remaining classes to C_i in the arithmetic space. For each C_i class there will be a collection of minimizing indexes and a formula for the distance from each object to C_i. An identified object P is related to one of the C_i classes. Several methods are proposed for assigning objects P to a class C_i. (tr-auth)

33338 DEAD-TIME CORRECTIONS FOR MULTIPLEXER ANALYSER SYSTEMS. Burgmer, W.; Klein, H. (Koeln Univ. (F. R. Germany). Inst. fuer Kernphysik). Nucl. Instrum. Methods; 123: No. 2, 371-377(15 Jan 1975).

Modern multiplexer analyzer systems use buffers either for the analog amplitude or for the converted digital result. The independent buffers are interrogated by free- or random-running scanners. Thus the dead time of a channel i is influenced by the count rate of the other channels. For the calculation of the dead-time corrections a system of coupled equations is derived which has to be solved numerically. In addition analytical solutions are given for a sufficient approximation using the accepted events of all channels and the time parameters of the analyzer system. (auth)

33339 A FAST MULTICHANNEL TIME RECORDER. Pizer, H. I. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 123: No. 3, 461-464 (1 Feb 1975).

Four scalars are used cyclically to allow up to 200 time-measurements to be made with a precision dictated by the 100 MHz clock. This compact instrument has been used successfully in a current Nuclear Physics experiment at CERN to measure the decay of μ-mesons in a muon storage ring. (auth)

33340 QUANTIZATION OF TIME INTERVALS IN THE REGISTRATION OF A NON-STATIONARY POISSON PROCESS. Jovic, F. (Institut Rudjer Boskovic, Zagreb (Yugoslavia)). Nucl. Instrum. Methods; 123: No. 3, 541-550(1 Feb 1975).

The registration of a non-stationary Poisson process is considered for conversion systems with fixed or variable quantization time. The quantization time is either stochastically or deterministically dependent. Probabilities of registration events are determined for conversion systems with arbitrarily given stochastic quantization time and for conversion systems with linearly dependent quantization time. Data losses in registration systems with fixed dead time and with constant quantization time are given. The analysis and results presented are valid for a registration system with an ideal memory. (auth)

33341 A WIDE RANGE TIME-TO-DIGITAL CONVERTER. Bialkowski, J.; Harms-Ringdahl, L.; Sztarkier, J. (Research Institute for Physics, S-104 05 Stockholm, Sweden). Nucl. Instrum. Methods; 123: No. 3, 605-608(1 Feb 1975).

A 128-channel time-to-digital converter with a resolution from 0.5 μs up to 0.45 s per channel is described. The time base is taken from a crystal oscillator, which can be replaced by an RC-

oscillator increasing the time width per channel up to 1000 s. The instrument is primarily designed for measurements of nuclear lifetimes longer than a few μs. The converter contains a read-out buffer which permits several time intervals to be measured with one common start pulse. A digital delay and a sampling function are incorporated in the instrument. Description and figures of merits are given. The measurement of a half-life in ^{180}W, produced in the pulsed beam from a cyclotron, is used as an illustration of the performance. (auth)

33342 A RANDOM PULSE GENERATOR. White, G. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nucl. Instrum. Methods; 123: No. 3, 575-578(1 Feb 1975).

A generator of random pulses is described, whose mean rate is accurately known and can be set from 10 pulses per second (pps) to over 10^7 pps. Measurements have shown that it is virtually free from aberrations in its time distribution and has many uses in nuclear instrumentation and other fields. (auth)

33343 ANALYSIS OF ^{236}U-FISSION PRODUCTS BY THE RECOIL SEPARATOR "LOHENGRIN". Moll, E.; Schrader, H.; Siegert, G.; Asghar, M.; Bocquet, J. P.; Bailleul, G.; Gautheron, J. P.; Greif, J.; Crawford, G. I.; Chauvin, C. (Institut Max von Laue-Paul Langevin, 38 - Grenoble (France)). Nucl. Instrum. Methods; 123: No. 3, 615-617(1 Feb 1975).

A mass separator for unslowed fission products is installed at the high-flux reactor at Grenoble. Well resolved mass spectra are obtained in the light and heavy fission-product groups. (auth)

33344 MULTIPLATE FOCUSING COLLIMATOR. Hoover, R. B.; Underwood, J. H. (to National Aeronautics and Space Administration). US Patent 3,869,615. 4 Mar 1975. Filed date 28 Jun 1973. 6p.

An apparatus for scanning relatively small near sources of penetrating radiation to obtain the energy distribution thereof, wherein a collimator assembly is interposed between a radiation source and a radiation detector is described. The collimator assembly has a plurality of plates aligned in parallel planes with respect to a common axis normal to their centers. All the plates have similar random distribution of apertures. All apertures on each plate are the same size. The size of respective plates, the size of the apertures of said respective plates, and the spacing between said respective plates vary precisely according to a predetermined ratio to produce radiation channels which converge to a focal point through corresponding ones of the similar random distribution of apertures of the plates. The radiation incident to the radiation detector is maximized when the focal point and the radiation source are coincident. (Official Gazette)

33345 SINGLE ELECTRON RESPONSE OF FAST PHOTOMULTIPLIERS. Broll, N.; Sipp, B.; Miehe, J. A. (Univ. Louis Pasteur, Strasburg). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 390-402(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

The single photoelectron response of several fast phototubes (RTC 56 DUVP, PM 2106, XP 1021, XP 1210 and RCA 8850, C 31024) has been measured using a sampling technique in conjunction with short light pulses and a fast oscilloscope. Results are presented. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

33346 INVESTIGATION OF THE DIFFUSION PROCESS AT ELECTROMAGNETIC SEPARATION OF THE RADIOACTIVE ISOTOPES OF RARE-EARTH ELEMENTS. Latuszynski, A. (Uniwersytet Marii Curie-Sklodowskiej, Lublin (Poland)). Nucl. Instrum. Methods; 123: No. 3, 489-494(1 Feb 1975).

Making use of the measurement results for the efficiency of migration of radioactive rare-earth elements out of the tantalum target, values have been found for the diffusion coefficients at different temperatures of the target. A concise theoretical consideration for the diffusion process is given which makes it possible to estimate the activity expected for the short-lived isotopes on the collector of the electromagnetic mass-separator in "off-line" and "on-line" modes. (auth)

33347 SEPARATION OF URANIUM ISOTOPES BY GASEOUS DIFFUSION. Aluminum Oxide and Polytetrafluoroethylene Barriers. Isomura, S.; Watanabe, T.; Nakane, R. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Rikagaku Kenkyusho Hokoku; 50: No. 3, 141-152(May 1974). (In Japanese).

Separation of uranium and argon isotopes by gaseous diffusion has been studied. The barriers are produced with aluminum oxide and polytetrafluoroethylene. The separation was carried out by a batch process and the single process separation factor was calculated from the theory of Rayleigh distillation. The results show that the correlation for the barrier separation efficiency between uranium isotopes and argon isotopes can be explained by the theory of Present and deBethune. (auth)

Isotopic Power Sources

Refer also to abstracts 32799-32801.

33348 (MLM-1317) PLUTONIUM-238 AND POLONIUM-210 RADIOISOTOPE FUELS. Kelly, D. P. (Mound Lab., Miamisburg, Ohio (USA)). 3 Jan 1966. Contract AT(33-1)-GEN-53. 35p. Dep. NTIS $4.75.

Declassified 30 Aug 1973.

The nuclear and physical properties are listed for the ^{238}Pu and ^{210}Po fuel forms currently being considered or used for terrestrial, marine, and aerospace power applications. Primary consideration is given to those properties pertinent to the design of heat sources. A review of the SNAP programs to date along with a review of and the fabrication procedures for heat sources fabricated at Mound Laboratory is presented. (auth)

33349 (MLM-1429) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: JULY-SEPTEMBER 1967. (Mound Lab., Miamisburg, Ohio (USA)). 12 Jan 1968. Contract AT(33-1)-GEN-53. 90p. Dep. NTIS $7.50.

Declassified 30 Aug 1973.

Progress during the period from July to Oct. 1967 in the development of ^{210}Po and ^{238}Pu heat sources is reported. (LCL)

33350 (MLM-1454) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: OCTOBER-DECEMBER 1967. (Mound Lab., Miamisburg, Ohio (USA)). 29 Mar 1968. Contract AT-33-1-GEN-53. 53p. Dep. NTIS $5.75.

Declassified 30 Aug 1973.

Progress during Oct. through Dec. 1967 in studies of ^{210}Po and ^{238}Pu fuels for power sources is reported. (LCL)

33351 (MLM-1493) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: JANUARY-MARCH 1968. (Mound Lab., Miamisburg, Ohio (USA)). 6 May 1968. Contract AT-33-1-GEN-53. 62p. Dep. NTIS $6.25.

Declassified 3 Mar 1975.

Progress during the period from Jan. to April 1968 in the development of ^{210}Po and ^{238}Pu heat sources and fuel capsules is reported. (LCL)

33352 (MLM-1527) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: JULY-SEPTEMBER 1968. (Mound Lab., Miamisburg, Ohio (USA)). 18 Nov 1968. Contract AT-33-GEN-53. 75p. Dep. NTIS $6.75.

Progress during the period from July to Oct 1968 in the development of ^{210}Po and ^{238}Pu heat sources and fuel capsules is reported. (LCL)

33353 (MLM-1528) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: OCTOBER-DECEMBER 1968. (Mound Lab., Miamisburg, Ohio (USA)). 31 Jan 1969. Contract AT(33-1)-GEN-53. 86p. Dep. NTIS $7.50.

Declassified 30 Aug 1973.

Progress during the period from Oct. through Dec. 1968 in studies of ^{210}Po and ^{238}Pu fuels for power sources is reported. (LCL)

33354 (MLM-1607) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: APRIL-JUNE 1969. (Mound Lab., Miamisburg, Ohio (USA)). 31 Jul 1969. Contract AT-33-1-GEN-53. 82p. Dep. NTIS $7.25.

Declassified 15 Apr 1975.

Progress during the period from April to July 1969 in the development of ^{210}Po and ^{238}Pu heat sources and fuel capsules is reported. (LCL)

33355 (MLM-1613) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: OCTOBER-DECEMBER 1969. (Mound Lab., Miamisburg, Ohio (USA)). 27 Feb 1970. Contract AT-33-1-GEN-53. 90p. Dep. NTIS $7.50.

Declassified 15 Apr 1975.

Progress during the period from Oct through Dec 1969 in the development of ^{238}Pu heat sources and fuel capsules is reported. (LCL)

33356 (PB-237558) IMPLANTED ENERGY CONVERSION SYSTEM. Annual Report, 8 July 1973-22 July 1974. Johnston, R. P.; Griffith, W. R.; Perrone, R. E.; Martini, W. R.; Emigh, S. G. (McDonnell Douglas Astronautics Co., Richland, Wash. (USA). Donald W. Douglas Labs.). Aug 1974. 209p. NTIS $7.25.

Radioisotope or stored thermal heat energy operates a Stirling engine module to produce hydraulic power. The hydraulic powered pump actuator module operates and controls either an assist or a full heart blood pump. The hydraulic fluid also transmits waste heat from the engine to the blood pump ventricles for dissipation to the body. A full system has operated an assist blood pump in-vivo for 175 h continuously and in-vitro for 842 h continuously and was terminated without failure. A similar engine continues to operate after 8821 h of continuous operation. The assist pump actuator has operated continuously for 3135 h without failure. The current implantable system can pump 12 liters/min of blood with 50 W input. A bench model of the next implantable system has shown that the heat requirement can be reduced to 33 W. A full heart actuator/controller is fabricated and is being readied for test. (GRA)

33357 (SC-TM-64-947) SNAP-9A INCIDENT SUMMARY. (Sandia Labs., Albuquerque, N. Mex. (USA)). 23 Jun 1964. 84p. (RS-7411/2). Dep. NTIS $7.25.

Declassified 28 Nov 1973.

At approximately 1:00 p.m. PST April 21, 1964, a Thor Ablestar was launched from PMR for the purpose of placing a SNAP-9A powered Transit 5 BN satellite in a polar orbit. Because of a guidance error, the vehicle failed to place the satellite in orbit and a ballistic path was followed resulting in re-entry of the satellite in the vicinity of the southeast coast of Africa. This report summarizes the post-launch analysis performed by various agencies. It includes reconstruction of the trajectory followed, estimates of the re-entry burnup of the satellite, and discussions of the possible fate of the plutonium fuel. (auth)

33358 EXPERIENCE WITH NUCLEAR POWERED PACEMAKERS (238 PLUTONIUM). Indications and Results. Reidemeister, J. C. (Essen Univ. (Gesamthochschule) (F. R. Germany). Abt. fuer Herz- und Thoraxchirurgie); Gleichmann, U.; Schulte, H. D.; Bircks, W. (Duesseldorf Univ. (F.R. Germany). Chirurgische Klinik und Poliklinik). Herz Kreislauf.; 6: No. 3, 101-105(Mar 1974). (In German).

An interim report is given on the clinical experience with the use of isotopic pacemakers up to August, 1973. There were 393 isotopic pacemakers implanted during this period, 260 of which were done in Europe. Technicalities and safety measures in relation to isotopic pacemakers are reported. The indications for the use of isotopic pacemakers, especially in relation to conventional batteries, are discussed. (auth)

Radiation Sources

Refer also to abstracts 33470, 35059, 35060, and 35199.

33359 (AED-CONF-74-509-002) MEASUREMENTS OF THE NEUTRON AND GAMMA TISSUE-DOSE RATES OF THE NEUTRON THERAPY SYSTEM AT THE UNIVERSITY HOSPITAL HAMBURG-

EPPENDORF. Cleland, M. R.; Wells, N. (Radiation Dynamics, Inc., Westbury, N. Y. (USA)). 1974. 16p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974).

With abstract.

The tissue-dose rates of the RDI/AEG fast-neutron therapy system were measured by the technique of paired ionization chambers. The gamma dose rate was only 2.3% of the neutron rate. The accuracy of this determination was improved by measuring the ratio of sensitivity of the two ion chambers in a pure neutron field. The absence of gamma rays in the narrow field used for the comparison was demonstrated by the lead-absorption method. The tissue-equivalent chamber was made of Shonka Type A-150 plastic. The neutron insensitive chamber was made of graphite (carbon). The comparison method used here for calibrating the graphite chamber permits meaningful measurements of the gamma/neutron ratio down to values as low as 1%. The accuracy of the neutron dose rate measurement was also improved by this procedure. The treatment beam intensity was 7.4 ± 0.7 rads per minute at 100 cm TSD. (auth)

33360 SOURCE STRENGTH OF THE STANDARD NEUTRON SOURCE OF THE PHYSIKALISCH-TECHNISCHE BUNDESANSTALT. Bortfeldt, J.; Matzke, M. PTB Mitt.; 84: No. 4, 254-256(Aug 1974). (In German).

The source strength of a Ra-Be (α,n)-neutron source is calculated from the measured distribution of thermal neutrons in a surrounding water bath. The mean value of the neutron source strength from five measurements is $(2.03 \pm 0.03) \times 10^6\ s^{-1}$. (auth)

Design and Fabrication

33361 (JAERI-M-5567, pp 63-67) APPLICATION OF ION IMPLANTATION TECHNIQUE TO FIXATION OF Kr-85. Kitani, S. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

In implantation of ^{85}Kr into aluminum was estimated for β utilization and deactivation of the radioactivity. The penetration of ^{85}Kr into aluminum is dependent on the crystal structure of the target. The stability of ^{85}Kr by heating was also discussed. For the deactivation of the radioactivity of ^{85}Kr by nuclear transmutation the high level neutron flux is necessary; for example the rate of deactivation by flux of 10^{15} n/cm^2·sec is estimated to be ten times compared to that of natural decay. (auth)

33362 A FLEXIBLE GAMMA SOURCE FOR INTRACAVITARY IRRADIATION OF MALIGNANT BRAIN TUMORS. I. Hori, S. (Tohoku Univ., Sendai (Japan). School of Medicine). Tohoku Igaku Zasshi; 86: No. 5-6, 259-265(Nov 1973). (In Japanese).

A new film-type gamma source, Gamma Film, was devised by the author for more convenient intracavitary contact irradiation of malignant brain tumors. The source was made of radioisotope and synthetic high polymers: aqueous solution of ^{60}Co-chloride was homogenously mixed with latex of styrenebutadiene copolymer and dried to a thin disc (about 0.5 cm^2 in area), which, as the active core of the source, was then covered with two thin films of silicone rubber. Space between the films was filled with a silicone adhesive. The source was thin (1 mm in thickness), soft and flexible and could be made into various sizes and shapes depending upon lesions to be irradiated. Some sources were silk-threaded for easy extracranial pull-out after irradiation without recraniotomy. The high polymers composing the source gradually hardened because of crosslinking in them due to radiation from inside: sources containing 0.6 to 3 mCi of ^{60}Co hardened in 18 to 24 months; the most intense one containing 8 mCi hardened and finally developed a crack on its surface 15 months after it was made. However, every source maintained its softness and flexibility at least for a year and was frequently used for an animal experiment without leakage of the isotope. (auth)

33363 A FLEXIBLE GAMMA SOURCE FOR INTRACAVITARY IRRADIATION OF MALIGNANT BRAIN TUMORS. II. Hori, S. (Tohoku Univ., Sendai (Japan). School of Medicine). Tohoku Igaku Zasshi; 86: No. 5-6, 266-281(Nov 1973). (In Japanese).

The film-type gamma source, Gamma film, made of ^{60}Co-chloride solution and synthetic high polymers, by the author's method (described elsewhere) was tested in an animal experiment for further clinical application to intracavitary irradiation of malignant brain tumors. Four disk-type sources, 16 mm in diameter and 1 mm in thickness, containing ^{60}Co of 0.6, 1.3, 3, or 8 mCi in the core of 0.5 cm^2 in area, were used in the present experiment. The exposure rate in an acrylic phantom at 1 cm from the center of the surface of these four sources was 5.2, 12.0, 27.5, or 76 R/hour respectively. For contact irradiation, the sources were inserted between the dura mater and surface of the suprasylvian gyrus through a craniotomy under general anesthesia in 22 normal adult cats and effects of the irradiation were assessed by histological and microangiographical methods. Since the 8 mCi source caused not only deterioration of general condition of the cats resulting in three deaths out of eight but generally broad and severe changes of the irradiated hemisphere even with irradiation for several days, such as diffuse swelling (some showed even a fungus formation through the craniotomy), diffuse demyelination in the white matter, degeneration of cortical and subcortical vessels and perivascular hemorrhage, such intense source was regarded as undesirable for clinical use. On the other hand, less intense sources such as containing 1.3 or 3 mCi of ^{60}Co which could deliver 13,000 to 14,000 R at 1 cm from the surface of the sources in a period 3 to 7 weeks caused marked histological changes within only shallow layers of the irradiated cerebrum close to the sources while preserving adjacent structures, and therefore, were considered to be suitable for intracavitary local irradiation in terms of avoiding radiation damage to the normal cerebral tissue surrounding target orain tumors. (auth)

Industrial Uses

Refer also to abstracts 32463, 33412, 33418, 33420, 33527, and 35650.

33364 (JAERI-M-5609) CHANGES IN ORGANOLEPTIC QUALITIES OF VIENNA SAUSAGES BY GAMMA IRRADIATION. 5. Radiation Preservation of Vienna Sausage. Watanabe, H.; Aoki, S.; Sato, T. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 11p. (In Japanese). INIS.

Changes in the organoleptic qualities of vienna sausages by gamma irradiation and the conditions of irradiation not affecting their qualities have been investigated. Packing in poly-cello (polyethylene-coated cellophane) bags does not affect qualities of the sausages when packed in the bags filled with nitrogen gas. The presence of oxygen in the bags influences markedly the organoleptic properties. The fading in color of the sausages occurs in irradiation at about 5°C, but not at 26°C. Off-flavor is observed when irradiated at about 26°C. The induction of "irradiation flavor" in the sausages is mitigated when the irradiation temperature is kept at about 5°C. In comparing the sausages irradiated to a dose of 0.6 Mrad at about 26°C with the unirradiated ones, the changes in both odor and taste are considerable in the former. The maximum dose which does not cause the deterioration in qualities of the vienna sausages, therefore, may be 0.5 Mrad. (auth)

33365 (NTIS/PS-74/119) FOOD PROCESSING. A Bibliography with Abstracts. Report for 1964-November 1974. Harrison, E. A. (National Technical Information Service, Springfield, Va. (USA)). Dec 1974. 223p. NTIS $20.00.

Supersedes COM-73-11795.

This bibliography contains 207 selected abstracts of research reports retrieved using the NTIS on-line search system-NTISEARCH. The abstracts include all types of food processing, but primarily cover food irradiation, fish protein processing, and freeze drying. (GRA)

33366 BASIS OUTLINES OF THE METHOD OF SURFACE ACTIVATION. pp 5-30 of Investigation and Control of Machines Wear by the Method of Surface Activation. Chapter 1. Postnikov, V. I. Moscow; Atomizdat (1973). (In Russian).

The method of surface activation is characterized as applied to the continuous and periodic control of machine part wear. The method is based on activation of the machine part by a beam of charged particles withdrawn from a cyclotron. A discussion is carried out on the basic theoretical principles of the surface activation method and on the basic parameters of cyclotron activation. Theoretical and experimental data are compared in investigating the depth of the activated layer with scintillation counters and registering equipment. An analysis is presented of methods of obtaining a given depth of activation. The effect of various factors on the activation depth and the distribution of radioisotopes along the depth is considered. The results of investigating energy spectra and decay measurements on standard samples after mathematical treatment of the experimental data are considered. (tr-SJR)

33367 SOME EFFECTS OF GAMMA RADIATION ON STRAWBERRIES. Haasbroek, F. J.; Truter, A. B.; Ginsburg, L.; De Villiers, J. F. (Fruit and Food Technology Research Inst., Stellenbosch (South Africa)). Agroplantae; 6: 7-42(1974).

The effect of gamma radiation treatments on decay, firmness, appearance and flavour of strawberries (cultivars Parfaite and Festival) was assessed. After irradiation the strawberries were first stored for 10 to 14 days at a temperature of -0.5°C and

thereafter for a further two and five days at 10°C. A dose of 200 krad strongly suppressed the decay of those samples having a high decay potential. At the same dose softening of the strawberries was detectable and organoleptic tests indicated slight preference in favour of unirradiated samples. A dose of 300 krad resulted in a high degree of softening of the strawberries. It is concluded from these results that for strawberries with a high decay potential, the beneficial effects of a dose of 200 krad may still overshadow the harmful effects. With increasing doses the contrary could apply. (INIS)

33368 INVESTIGATION AND DEVELOPMENT OF THE SURFACE ACTIVATION METHOD UNDER LABORATORY AND BENCH TESTS. pp 31-53 of Investigation and Control of Machines Wear by the Method of Surface Activation. Chapter 2. Postnikov, V. I. Moscow; Atomizdat (1973). (In Russian).

A description is given of studies on modeling the wear of various metals in samples activated in a cyclotron. Count rate was determined as a function of sample wear during measurements under various conditions. Descriptions are given of studies on a machine part in an operating engine and on a bushing as a function of diameter oversize. A comparison is carried out of the results of wear measurements by the method of surface activation and by making micrometer measurements or light magnification measurements. A study was made of the effect of reflected gamma radiation on measuring the count rate. (tr-SJR)

33369 INVESTIGATION INTO WEAR OF MACHINE PARTS AND MECHANISM. pp 106-132 of Investigation and Control of Machines Wear by the Method of Surface Activation. Chapter 5. Postnikov, V. I. Moscow; Atomizdat (1973). (In Russian).

Results are described on studies dealing with the effect of various factors on the wear of machine parts of internal combustion engines. The basic features of carrying out the tests with the use of the surface activation method are characterized. The effect of various factors on wear was determined from the results of 60-h tests. Various wear curves were constructed. A schematic outline is given for investigating wear of a worm gear. A determination is made of the effect of the error in the standard curves on the accuracy of wear measurements. (tr-SJR)

33370 TECHNICAL AND ECONOMIC SUBSTANTIATION OF RADIOISOTOPE APPLICATION FOR WEAR CONTROL. pp 135-162 of Investigation and Control of Machines Wear by the Method of Surface Activation. Chapter 6. Postnikov, V. I. Moscow; Atomizdat (1973). (In Russian).

A presentation is given of the technical-economic validity of using radioactive isotopes for the control of machine part wear. A presentation is given of a scheme of classifying research studies and test methods available for the technical-economic analysis. The technical-economic parameters were characterized for the surface activation method. Concrete results are considered in the use of the surface activation method for investigation of the wear of various machine parts, and a presentation is made of calculations which determine the expenditures for carrying out the tests and the economic effect from using the surface activation method. (tr-SJR)

33371 MATHEMATICAL TREATMENT OF THE RESULTS OF WEAR MEASUREMENTS. pp 54-82 of Investigation and Control of Machines Wear by the Method of Surface Activation. Chapter 3. Postnikov, V. I. Moscow; Atomizdat (1973). (In Russian).

The relation between sample wear and a measurement of its activity is expressed mathematically. The change in activity and count rate is given as a function of time after the introduction of corrections. The application of a method of finding empirical functions is shown in determining the wear of activated machine parts. An algorithm is given for the mathematical treatment of data on a computer, and a mathematical analysis of the accuracy of the tests is presented. A determination is made of decay coefficients used in calculations of machine part wear, and the corresponding nomograms are presented. Standard curves of sample wear were obtained, and equations are given for the standard curves. (tr-SJR)

33372 SOME PROBLEMS OF INSTRUMENTATION SPECIFICATIONS FOR THE SURFACE ACTIVATION METHOD. pp 83-105 of Investigation and Control of Machines Wear by the Method of Surface Activation. Chapter 4. Postnikov, V. I. Moscow; Atomizdat (1973). (In Russian).

Existing gamma detectors used for studying machine part wear are characterized. A relative estimate is given of gamma registers based on self-quenching Geiger–Muller counters and scintillators. Recommendations are given for instrumentation specification in using the surface activation method, in particular, in selecting the type of scintillator and gas counter on the basis of efficiency, reliability and stability, and also in selecting the mode of use. A description is given of the structural components of the measurement equipment, and also of the equipment for continuous registration of machine part wear. A new type of unit, the wear-meter RIM-1, is presented. (tr-SJR)

33373 EFFECT OF GAMMA RAYS ON SHELF LIFE AND QUALITY OF ORANGE JUICE. Hussain, A.; Maxie, E. C. (Univ. of California, Davis). Int. Biodeterior. Bull.; 10: No. 3, 81-86 (1974).

Effective radurization of orange juice with quality approaching normal was achieved by a dose of 300 Krad gamma rays followed by heating for 20 min at 50°C. Loss in ascorbic acid and total carotenoids was greater by radiation alone (1000 Krad) as compared to the combined irradiation-heat treatment. Storage and taste panel studies confirmed that samples treated with radiation followed by heating were better than those subjected to radiation alone. (auth)

33374 IMPROVEMENT OF CREASE RESISTANCE OF COTTON FABRIC BY THE GRAFTING WITH ACRYLIC ACID AND AFTERTREATMENT WITH TRIS (1-AZIRIDINYL) PHOSPHINE OXIDE. Ikeda, T.; Ikeda, Y.; Ito, S.; Tsuji, W. (Kyoto Univ., Uji (Japan). Inst. for Chemical Research). Sen'i Gakkaishi; 30: No. 5-6, T292-T298(May 1974). (In Japanese).

Crease recovery of cotton fabric grafted with acrylic acid and further treated with tris (1-aziridinyl) phosphine oxide (APO) was studied with a view of preventing the decrease of tensile strength accompanied with crosslinking. Although the chemical structure of reaction products of APO with acrylic acid grafted cotton is more complicated owing to the presence of the carboxyl groups in the grafted polyacrylic acid than that of the reaction products of APO with ungrafted cotton, APO seems to react not only with hydroxyl groups in the cotton cellulose, as observed for the ungrafted cotton, but also with carboxyl groups in the grafted cotton fabric. Crease recoveries of ungrafted and grafted cotton fabrics in both conditioned and wet states were much improved by treating with APO solution containing 2.5% zinc fluoroborate catalyst. Considerable crease-proofing effect was also observed when the grafted cotton fabrics are treated with APO solution without zinc fluoroborate catalyst, and the decrease in the warp tensile strength was prevented by this treatment. This method is particularly favorable to obtain a good crease recovery–strength relationship. (auth)

33375 THE DIFFUSION OF GASES AT HIGH PRESSURES. V. The Diffusion of CTH_3 in the Co_2–Ar System. Takahashi, S. (Tohoku Univ., Sendai (Japan). Chemical Research Inst. of Non-Aqueous Solutions). Bull. Chem. Soc. Jap.; 47: No. 6, 1342-1345(Jun 1974).

The diffusion coefficients of radioactive methane (CTH_3) in argon and in mixtures of carbon dioxide with argon (0.719, 0.497, and 0.245 mol fractions of argon) were measured at the temperatures of 25, 50, and 75°C in the 15~250 atm pressure range. The measurements were made through a plug of porous bronze in the diffusion cell by using the radioactive tracer technique. The diffusion coefficient-density products, D_ρ, for the CTH_3–argon system increased slightly with the density in the region below 5 mol/1, and decreased slightly in the region above 5 mol/1. The D_ρ for the CTH_3-mixture systems decreased slightly with the density over the whole range studied here. The density dependence of D_ρ-values at high densities could not be predicted by Enskog-Thorne's theory. (auth)

33376 INVESTIGATION OF THE ADSORPTION OF SULPHATE IONS ON NICKEL USING ^{35}S AS RADIOTRACER. Enterlein, G.; Feller, H. G. (Technische Univ. Berlin (F. R. Germany). Inst. fuer Metallforschung). Z. Metallk.; 65: No. 11, 697-701(Nov 1974). (In German).

The anodic behavior of polycrystalline nickel and monocrystals of low indices has been studied in 1N sulphuric acid. Current density and capacitance-potential curves of different sulphate-covered nickel have been measured by use of radiotracer ^{35}S. The exchange between radioactive and inactive sulphate ions on the metal surface was investigated for different polarization potentials. Increasing potential above 100 mV_H results in a decrease of the exchange rate. (auth)

33377 THE EFFICIENCY OF SODIUM PROPIONATE AND BHT IN IRRADIATED BACON AND CANTON SAUSAGE. Rivera, L. S.; Pastor, S. C.; Albano, Z. F.; Mangawang, L. A.; Madlangsakay, P. L. (Bureau of Animal Industry, Manila (Philippines)). Proc. Radioisotope Soc. Philipp.; 64-73(1973).

Two meat products, namely Canton sausage and bacon, were processed according to standard procedures. Each product was divided into eight lots with the following treatments: Lot 1 - Control, no treatment; Lot 2 - Control, irradiated at 3 MR; Lot 3 - Treated with 0.01% BHT; Lot 4 - Treated with 0.01% BHT, irradiated at 3 MR; Lot 5 - Treated with 0.01% sodium propionate;

Lot 6 - Treated with 0.1% sodium propionate, irradiated at 3 MR; Lot 7 - Treated with .01% BHT and 0.1% sodium propionate; Lot 8 - Treated with 0.01% BHT and 0.1% sodium propionate, irradiated at 3 MR. Irradiation was performed at the Philippine Atomic Research Center (PARC). All lots were divided into three groups such that one was stored at room temperature, one at refrigerated temperature and a small amount of samples at freezing temperature for rancidity test only. The following tests were used to evaluate samples: (1) Bacterial count using the quantitative dilution technique; (2) Rancidity test using the Taufel and Sadler Technique; 3) Mold growth observation; 4) Organoleptic evaluation. Results of these tests are presented in tabulated forms. From the results, it was concluded that: (1) Irradiation only reduces the bacterial population in bacon and Canton sausage stored under refrigeration and freezing except when combined with BHT and freezing temperature that it completely eradicates the microorganisms present; (2) The carry through effect of BHT was demonstrated by the delayed onset of rancidity from 8 to 20 weeks in both products especially under refrigerated and freezing temperatures even in combination with irradiation; (3) The effect of sodium propionate in both products was not very satisfactory, although for a short while it inhibited mold growth; and (4) That irradiation adversely affected the color, odor, and texture of the products. (INIS)

LIFE SCIENCES

33378 (LBL-3227) INSTRUMENTATION FOR ENVIRONMENTAL MONITORING IN BIOLOGICAL SYSTEMS. Amer, N. M.; Graven, R. M.; Budnitz, R. J.; Mack, D. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1974. Contract W-7405-eng-48. 3p. (CONF-741213-15). Dep. NTIS $4.00.

From nuclear science symposium; Washington, District of Columbia, USA (11 Dec 1974).

The status of instrumentation for monitoring the effects of pollutants in biological systems varies from one pollutant to the next. Techniques are well in hand for detecting trace metals (Pb, Hg, Cd, Ni), pesticides, herbicides, and ionizing radiation. This is not the case for gaseous (CO, SO_2), and liquid pollutants. Asbestos and other microparticulates present a unique problem where lung tissue samples have to be analyzed to ascertain the extent of exposure. However, once a sample is obtained, rather sophisticated techniques such as electron microscopy and electron microprobe analysis are used to identify the degree of exposure to this potentially serious pollutant which seems to be more prevalent in U. S. waterways than previously suspected. (auth)

Radiation Effects on Biochemicals

Refer also to abstracts 33413 and 33486.

33379 (AED-CONF-74-440-014) THE RADIATION-INDUCED DECARBOXYLATION OF SOLID L-β-PHENYLALANINE-1-^{14}C. Merwitz, O.; Thiemann, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Physikalische Chemie). 1974. 6p. (In German). INIS.

From annual meeting of the Deutsche Gesellschaft fuer Biophysik e.V.; Freiburg im Breisgau, F. R. Germany (2 Oct 1974).

Available from ZAED.

L-β-phenylalanine was irradiated in the solid state with a ^{60}Co source with doses of 50 to 5×10^6 rad in vacuum. The radioactivity of the $^{14}CO_2$ released was measured in gas filling counter tubes with anticoincidence circuit and the dose effect curve was determined. The dose-dependent G-values calculated neglecting the isotope effect were very high. This allowed one to conclude that a chain reaction is involved in the radiation-induced decarboxylation of the phenylalanine. Together with the decreasing decarboxylation due to the formation of phenylethyl amine, deamination and possibly racemization of the L-phenylalanine also occurs. All three processes should lead to a reduction of the optical activity. The ORD measurements of the dissolved irradiation samples, however, exhibited no decrease of the specific rotation. This result is discussed in connection with the mechanism of the radiation damage. (GE)

33380 (COO-3095-13) ULTRAVIOLET LIGHT EFFECTS ON NUCLEIC ACID FORMATION AND GENETIC EVENTS IN BACTERIA. Final Progress Report, August 1, 1971–July 31, 1974. Doudney, C. O. (Albert Einstein Medical Center, Philadelphia, Pa. (USA). Dept. of Genetics). 1974. Contract AT(11-1)-3095. 16p. Dep. NTIS $4.00.

With the antibiotics, rifampicin and chloramphenicol, it was shown that RNA synthesis independent of protein synthesis, which could be blocked by chloramphenicol, is involved in the reinitiation and continuation of DNA replication with uv-damaged E. coli B/r. Increasing uv doses were found to limit more and more the capacity for DNA replication in the presence of chloramphenicol by inactivation of active DNA replication sites. Loss of photoreversibility of uv-damaged blocking DNA replication occurred at exactly the time of initiation of DNA replication suggesting that the photoreversible damage blocking DNA synthesis is to the initiation system. The shoulder of the dose inactivation curves for both colony formation and DNA synthesis were increased greatly when protein synthesis was inhibited before uv irradiation. Preirradiation inhibition of protein synthesis increased considerably the colony-forming and DNA-replication ability of uv-irradiated her- and rec- strains. Thus the mechanism is independent of both the excision-repair and recombination-repair system. Two types of mutation to streptomycin resistance are induced by uv only one of which shows the mutation frequency decline response to inhibition of protein synthesis. The other type shows immediate loss of photoreversibility suggesting that mutation results from the gap produced by dimer excision. (auth)

33381 (LA-5883-PR, pp 63-102) CELLULAR AND MOLECULAR RADIOBIOLOGY. Feb 1975.

In biomedical and environmental research program of the LASL Health Division. Annual report, January–December 1974.

The research activities of the Cellular and Molecular Radiobiology Group include: studies with model DNA polymers; cell surface studies; cytogenetics; and microbial studies. The studies with model DNA polymers include: chemical synthesis of obgodeoxyribonucleotides; radiation chemistry of models for DNA; effects of x irradiation of DNA on transcription; buoyant densities considered as sequence-dependent properties; circular dechroism spectra of synthetic polynucleotides; modification of RNAs; messenger-related RNA metabolism in cultured Chinese hamster cells; involvement of histone phosphonylation with cell proliferation, DNA replication, and chromosome condensation; unique techniques for cell-cycle analysis using mithramycin and flow microfluorometry; effects of x irradiation on DNA precursor metabolism and deoxyribonucleotide triphosphate pools in Chinese hamster cells; and cell-cycle specific changes in the organization of chromatin in mammalian nuclei. The cell surface study consists of a population analysis of arrested human diploid fibroblasts by flow microfluorometry. The cytogenetics study is on the nature of chromosome instability in heteroploid cell populations. The microbial studies include: increased frequencies of lysogeny in heavily uv-irradiated populations of temperate bacteriophage; and the development of bacterial virus Hplc1 after uv-induction of temperature-sensitive mutants of phage Hplc1. (ERB)

33382 DEMONSTRATION THAT THYMINE DIMERS ARE EXCISED AS OLIGONUCLEOTIDES FROM SPECIFICALLY INCISED ULTRAVIOLET-IRRADIATED DEOXYRIBONUCLEIC ACID. Pawl, G.; Sior, H.; Friedberg, E. C. (Stanford Univ., CA). J. Bacteriol.; 122: No. 1, 341-344(Apr 1975).

The average size of the dimer-containing acid-soluble oligonucleotides after incubation of specifically incised DNA with two dimer excising nuclease activities has been determined to be about eight nucleotides. (auth)

33383 TRYPTOPHAN PHOTOPRODUCT(S): SENSITIZED INDUCTION OF STRAND BREAKS (OR ALKALI-LABILE BONDS) IN BACTERIAL DEOXYRIBONUCLEIC ACID DURING NEAR-ULTRAVIOLET IRRADIATION. Yoakum, G. H. (Argonne National Lab., IL). J. Bacteriol.; 122: No. 1, 199-205(Apr 1975).

Long-wavelength ultraviolet light (300 to 400 nm) converts L-tryptophan to a photoproduct that is toxic for bacterial cells in dark conditions. We now report that similar photoproducts of L-tryptophan sensitize bacterial deoxyribonucleic acid to 365-nm radiation, increasing the yield of deoxyribonucleic acid strand breaks (or alkali-labile bonds) by approximately 11.5-fold. Evidence is also presented which indicates that these sensitized deoxyribonucleic acid lesions contribute to lethality for Escherichia coli irradiated with 365-nm ultraviolet light in suspensions of tryptophan photoproducts. (auth)

33384 ROLE OF DISULFIDE BOND DISRUPTION IN ULTRAVIOLET INACTIVATION OF ENZYMES AND HORMONES. Karolczyk-Kostuch, S.; Zubek, M. (Akademia Rolnicza, Krakow (Poland)). Postepy Biochem.; 19: 471-482(1973). (In Polish).

Probable mechanisms of inactivation of some cystine-containing enzymes and hormones under uv irradiation are reviewed. (auth)

33385 THE EFFECT OF FRACTIONATED IRRADIATION ON THE ACTION OF CHLORPROMAZINE. Danysz, A.; Krysicka-Doczkal, H.; Szafran, H. (Instytut Lekow, Warsaw (Poland)). Postepy Fiz. Med.; 8: 219-227(1973). (In Polish).

The effect of fractionated irradiation in a dose of 100 R daily for 9 successive days on the central action of chlorpromazine centres, on its binding to blood proteins, on the level in tissues, and on its excretion is discussed. On the 6th and 15th day after the last exposure the psychodepressive action of chlorpromazine was found to be lower for doses of 2 and 3 mg/kg but was unaltered for the dose of 4 mg/kg. The level of chlorpromazine in the brain was also found to be lower, but its binding to the blood proteins and the excretion of chlorpromazine sulphoxide in urine was higher. (auth)

33386 RATE CONSTANTS FOR THE REACTIONS OF OH RADICALS WITH THE ENZYME PROTEINS AS DETERMINED BY THE p-NITROSODIMETHYLANILINE METHOD. Masuda, T.; Nakano, S.; Kondo, M. (Tokyo Metropolitan Univ. (Japan). Faculty of Science). J. Radiat. Res.; 14: No. 4, 339-345(Dec 1973).

Rate constants for the reactions of OH radicals with commonly occurring amino acids and several enzyme proteins were determined by the competition kinetics using p-nitrosodimethylaniline. From the assumption that the reaction of OH radicals with an amino acid residue is restricted to the surface region of enzyme molecule, an estimation of rate constant for the reaction of OH radicals with enzyme was attempted. The calculated values for

cytochrome c and lysozyme were in good agreement with those obtained experimentally. (auth)

33387 TRYPTOPHAN PHOTOPRODUCT(S): SENSITIZED INDUCTION OF STRAND BREAKS (OR ALKALI-LABILE BONDS) IN BACTERIAL DEOXYRIBONUCLEIC ACID DURING NEAR-ULTRAVIOLET IRRADIATION. Yoakum, G. H. (Argonne National Lab., IL). J. Bacteriol.; 22: No. 1, 199-205(Apr 1975).

Long-wavelength ultraviolet light (300 to 400 nm) converts L-tryptophan to a photoproduct that is toxic for bacterial cells in dark conditions. We now report that similar photoproducts of L-tryptophan sensitive bacterial deoxyribonucleic acid to 365-nm radiation, increasing the yield of deoxyribonucleic acid strand breaks (or alkali-labile bonds) by approximately 11.5-fold. Evidence is also presented which indicates that these sensitized deoxyribonucleic acid lesions contribute to lethality for Escherichia coli irradiated with 365-nm ultraviolet light in suspension of tryptophan photoproducts. (auth)

33388 DEMONSTRATION THAT THYMINE DIMERS ARE EXCISED AS OLIGONUCLEOTIDES FROM SPECIFICALLY INCISED ULTRAVIOLET-IRRADIATED DEOXYRIBONUCLEIC ACID. Pawl, G.; Slor, H.; Friedberg, E. C. (Stanford Univ., CA). J. Bacteriol.; 122: No. 1, 341-344(Apr 1975).

The average size of the dimer-containing acid-soluble oligonucleotides after incubation of specifically incised DNA with two dimer excising nuclease activities has been determined to be about eight nucleotides. (auth)

33389 SOME VOLATILE COMPOUNDS FORMED DURING γ IRRADIATION OF CORN STARCH. Berger, G.; Agnel, J. P.; Saint-Lebe, L. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)). Staerke; 26: No. 6, 185-189(1974). (In French).

Acetaldehyde, methanol, acetone, small amounts of methylformate and various amounts of ethanol were found in ^{60}Co γ-irradiated maize starch by means of gas chromatography combined with mass spectrometry. Investigations were made on the influence of radiation dose, temperature, atmospheric composition during irradiation, water content, and impurities on the formation of the first three compounds. The effect of irradiation was compared with the effect of a thermal treatment and the changes of concentration during storage were observed. (GE)

33390 OXYGEN EFFECT: DIFFERENCES IN RADIATION-INDUCED DEACTIVATION OF MOBILE AND IMMOBILIZED α-CHYMOTRYPSIN. Kasche, V. (Uppsala Univ. (Sweden). Gustaf Werner Institutet). Radiat. Environ. Biophys.; 11: No. 3, 189-193(Oct 1974).

Oxygen was found to sensitize the radiation-induced deactivation of immobilized α-chymotrypsin, but protected the free enzyme in solution. In the system with immobilized enzyme, radiation-induced enzyme deactivation can only occur in the small volume element where the enzyme is located. Oxygen should, therefore, reduce radical recombination outside this volume element, resulting in an increased number of radical ($\times$ OH, $\times$ O_2^-, $\times$ HO_2)-immobilized enzyme reactions. The results then indicate that most of the solvent radicals are terminated within 50 A from the point of origin. (auth)

33391 INFECTIOUS DNA FROM COLIPHAGE T1. V. Detection of Gamma-Radiation-Induced Latent Double-Strand Breaks by Cysteamine. Hotz, G. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Strahlenbiologie). Radiat. Environ. Biophys.; 11: No. 2, 157-164(Jun 1974).

Infectious DNA from coliphage T1 suspended in 4% Difco nutrient broth was inactivated by ^{60}Co gamma rays in the absence and in the presence of 0.1 M cysteamine · HCl (CSH). The influence of CSH on the occurrence of radioinduced double (dsb) and single strand breaks (ssb) as well as on the inactivation of infectivity (lethal event) was studied. The ratio of dsb to lethal event rises by about 60% from 0.18 in the absence to 0.29 when irradiated in the presence of CSH. However, an equal number of dsb is produced by treatment with CSH after irradiation. These additional dsb do not increase radiation damage to the biological activity of infectious DNA. It is suggested that CSH breaks labile bonds in native DNA at sites of radiation lesions unknown so far. These CSH-labile bonds in double-stranded DNA are alkali-labile in denatured DNA. The biological relevance of DNA breaks measured by ultracentrifugation is discussed in the light of these findings. (auth)

33392 OXYGEN EFFECT ON γ-IRRADIATED DNA. Frey, R.; Hagen, U. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Strahlenbiologie). Radiat. Environ. Biophys.; 11: No. 2, 125-133(Jun 1974).

The DNA from bacteriophage T1 or calf thymus DNA was γ-irradiated in dilute solution at 200 μg/ml in absence and in presence of oxygen. A variety of physico-chemical and biological properties was measured and the respective oxygen enhancement ratios (o.e.r.) were calculated. For the occurrence of single and double strand breaks, formation of terminal phosphate end groups and for the base damage, o.e.r.-values between 2 to 4 were measured. Whereas the formation of actual breaks results in an o.e.r. of 1.8, the induction of alkali-labile lesions in the nucleotide strand seems to occur rather exclusively in the presence of oxygen. In contrast to physico-chemical alterations, the inactivation of biological functions does not show any oxygen effect as determined by the priming activity of thymus DNA with respect to enzymatic RNA synthesis or by the infectivity of T1-DNA in a spheroplast system with E. coli hcr$^+$ (K12) or hcr$^-$ (K12 A16). The discrepancy between the o.e.r. for biological inactivation and that for the structural damage in DNA is discussed. (auth)

33393 INFLUENCE OF X-RAY AND ULTRAVIOLET RADIATION ON THE DIURNAL RHYTHM OF ACID PHOSPHATASE ACTIVITY AND INORGANIC PHOSPHATE LEVEL IN THE THYMUS OF SEXUALLY IMMATURE AND MATURE MICE. Barbacka, G. (Universytet Jagiellonski, Krakow (Poland). Instytut Zoologii). J. Interdisciplinary Cycle Res.; 5: No. 2, 95-114 (Sep 1974).

Humoral and immunologic activity of the thymus in the postnatal period and during sexual maturity were studied on the basis of acid phosphatase activity, which is a sensitive indicator of the activities of many endocrine glands. The aim of study was to ascertain whether acid phosphatase activity and inorganic phosphate levels show 24-hr variations during selected periods of life i.e. in the third and eighth week after birth. Desynchronization of the rhythm under the influence of X-ray and ultraviolet radiation was also studied. The data demonstrated a distinct 24-hr rhythm of acid phosphatase activity and inorganic phosphate levels in both groups of animals. Ultraviolet and x radiation markedly desynchronized the rhythm. It was concluded that a 24-hr rhythm in young as well as sexually mature animals indicates that the thymus is active throughout the life of the animals. The marked involvement of the thymus in the metabolism of nucleic acids and the 24-hr variation in its enzymatic activity suggests that the function of the thymus is not only an immunologic one. (INIS)

33394 EFFECT OF IRRADIATION ON REDOX REACTIONS OF HUMAN HEMOGLOBIN. Puchala, M.; Leyko, W. (Lodz Univ. (Poland)). Acta. Chim., Soc. Sci. Lodz.). 18: 195-201 (1973).

Human hemoglobin was irradiated with gamma radiation at 10^3 to 10^5 rad. Redox potentials of Hb-MetHb were measured by the compensation method, using titration of deoxyhemoglobin with kalium ferricyanide. Decrease of normal potential of hemoglobin and of n value was observed. After irradiation with a dose of 4.75 Mr the observed E_0 decrease amounted to about 45 mV. Values of free energy indicated that after irradiation the redox reaction of hemoglobin is less spontaneous. (INIS)

33395 REPAIR OF DNA DAMAGES IN ESCHERICHIA COLI. Suzuki, K. (National Inst. of Radiological Sciences, Chiba (Japan)). Tanpakushitsu Kakusan Koso; 19: No. 8, 571-582 (Aug 1974). (In Japanese).

Repair of DNA damages by ultraviolet light and x ray in Escherichia coli was explained. Concerning pyrimidine dimer caused by ultraviolet, there are two kinds of repair mechanisms in Escherichia coli which are excision repair and post-replication repair, and it is said that there are only two kinds. This dark repair mechanism such as excision repair and recombinational repair was explained by action of a gene which showed the highest sensitivity to ultraviolet. All except ultra-high speed type recombination of one chain break by x ray influenced on repair synthesis which got the central position in repair mechanism. The system, which was thought to be complicated repair system of repair synthesis and repair system putting emphasis on recombination, was discussed. Furthermore, other factors, which largely control radioresistance of cells by repair system which showed its capacity sufficiently, were discussed and explained. (JA)

33396 GENETIC REPAIR SYSTEM IN YEAST. Nakai, S. (National Inst. of Radiological Sciences, Chiba (Japan)). Tanpakushitsu Kakusan Koso; 19: No. 8, 610-624(Aug 1974). (In Japanese).

The present conditions of genetic repair mechanism of yeast as eukaryote were given an outline. By putting emphasis on Saccharomyces cerevisiae, its genetic characteristics were discussed and mutual genetic recombination between DNA of mitochondria was analyzed. With respect to radiosensitivity (repair) gene system, ultraviolet and x-ray sensitivity mutants were analyzed genetically, and relationship to its specificity and repair function was discussed. Furthermore, participation of repair gene as cause of genetic variation was discussed from a viewpoint of function of ultraviolet and x-ray sensitivity gene and

repair function of defective gene. Lastly, presence of repair system special for eukaryote was discussed and explained from a viewpoint of radiosensitivity of diploid and haploid, repair by fractionated irradiation and repair of zygote-type genes. (JA)

33397 EFFECT OF ALKALI TREATMENT ON SINGLE-STRAND BREAKS IN IRRADIATED DRY PhiX 174 RF-DNA. Luecke-Huhle, C.; Pech, M. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Strahlenbiologie); Jung, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Strahlenbiologie; Hamburg Univ. (F. R. Germany). Inst. fuer Biophysik und Strahlenbiologie). Radiat. Environ. Biophys.; 11: No. 2, 165-170(Jun 1974).

Twenty-two percent of the single-strand breaks produced in dry RF-DNA from bacteriophage PhiX 174 after γ irradiation were found to be due to alkali-labile bonds. No such effect was found after exposure to metastably excited hydrogen gas. (auth)

33398 ESR INVESTIGATIONS ON RADICAL FORMATION AFTER ULTRAVIOLET IRRADIATION OF TRYPSIN IN VARIOUS POLAR AND NONPOLAR MEDIA. Nemec, H. W.; Moenig, H. (Freiburg Univ. (F. R. Germany). Inst. fuer Biophysik und Strahlenbiologie). Radiat. Environ. Biophys.; 11: No. 3, 227-238(Oct 1974).

Crystalline trypsin was irradiated with ultraviolet light of 254 nm in various oxygen-free suspension media at a temperature of 278 K. Using electron spin resonance spectroscopy, long-living free radicals were detected in the enzyme. Unpaired electrons are mainly localized at C_α-atoms of the polypeptide chain and at the sulphur of damaged disulfide bridges. The ultraviolet irradiation of trypsin leads to greater yields of thiyl radicals in nonpolar media than in polar ones. If the dielectric constant is chosen as a measure of polarity a relationship between the relative concentration of thiyl radicals and the dielectric constant epsilon in form of [RS-radical]rel approximately 1/epsilon is obtained. The manner how the suspension media may influence the formation of thiyl radicals is discussed. The results allow the conclusion that the radiation-induced scission of disulfide bonds is of significance for the inactivation of trypsin. (auth)

Radiation Effects on Cells

Refer also to abstracts 33335, 33439, 33486, and 33517.

33399 (AED-CONF-74-440-011) DNA SYNTHESIS OF SYNCHRONIZED L-CELLS FOLLOWING IRRADIATION IN THE G_1-PHASE. Incorporation Studies and Pulse Cytophotometric Measurements. Koenig, K.; Linden, W.; Baisch, H. (Hamburg Univ. (F. R. Germany). Inst. fuer Biophysik und Strahlenbiologie). 1974. 10p. (In German). INIS.

From annual meeting of the Deutsche Gesellschaft fuer Biophysik e.V.; Freiburg im Breisgau, F. R. Germany (2 Oct 1974).

L-929 cells of the mouse were synchronized by mechanical selection of the mitosis cells. Five hours after the synchronization, i.e., in the middle of the G_1 phase, the cells were irradiated with an x-ray dose of 1,000 rad. Following that, the incorporation of ^{3}H-thymidine in DNA after a 60 minute pulse and the DNA content of the single cells in the synchronous populations was investigated by means of pulse cytophotometry (ICP) over a period of 30 hours. Irradiation caused a reduction of the DNA synthesis rate in the following S phase of 50%. The ICP measurements showed that the duration of the S phase was about twice as long compared to the nonirradiated controls. Irradiation caused furthermore the formation of a very distinct G_2 block. Although the DNA synthesis rate as well as the cell progression through the cell cycle and the duration of the single phases due to irradiation in G_1 experienced severe changes, an almost whole complement of DNA was synthesized. (GE)

33400 (BNL-50418, pp 1-16) CLASSIFICATION, FUNCTION, AND INTERACTIONS OF LYMPHOCYTES. Waksman, B. H. (Yale Univ., New Haven). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

Studies on lymphocytes are reviewed with regard to: techniques including the use of x radiation and radioisotopes; lymphoid organs; types of lymphocytes; surface markers; receptors; life span and recirculation; triggering; lymphokines; cooperation, suppression, and tolerance; and other types of lymphocytes. (HLW)

33401 (BNL-50418, pp 99-118) PRINCIPLES OF RADIATION BIOLOGY. Belli, J. A.; Piro, A. J. (Joint Center for Radiation Therapy, Boston). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

It is emphasized that the most important end point in assessing the biological expression of radiation damage is the destruction of the capacity for unlimited division of tumor cells. The use of the destruction of the capacity for unlimited division as an end point in radiobiological studies is discussed in relation to survival curve properties, cell cycle effects, the oxygen effect, repair properties of mammalian cells, drug-x-ray interactions, and the effect of x rays on the sedimentation properties of mammalian cell DNA. (HLW)

33402 (BNL-50418, pp 119-129) RADIOBIOLOGICAL BASIS OF RADIOTHERAPY. Withers, H. R. (Univ. of Texas, Houston). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction radiation and host immune defense mechanisms in malignancy.

The following topics are discussed: the random nature of cell killing; effectiveness of dose fractionation in radiotherapy; reoxygenation; redistribution of cells throughout the division cycle; regeneration; rejection; and ratio of clonogenic cells. (HLW)

33403 (BNL-50418, pp 130-151) CONSIDERATIONS IN THE INTERACTIONS OF RADIATION AND IMMUNOTHERAPY. Suit, H. D. (Massachusetts General Hospital, Boston); Order, S. (Massachusetts General Hospital, Boston). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

The role played by the host immune rejection response as an assist to radiotherapy in achieving tumor destruction is reviewed. Some topics discussed are tumor growth phase; tumor regression; phase of no evident tumor; tumor regrowth probability; time distribution of recurrence; immunosuppressive effects of radiation; and effects of radiation on the macrophage, lymphocytes, and antibody response. (HLW)

33404 (BNL-50418, pp 207-224) EFFECT OF RADIATION ON THE LYMPHOCYTE RESPONSE TO MITOGENS. Belli, J. A.; Timberlake, N.; Hellman, S. (Joint Center for Radiation Therapy, Boston). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

Cultures of human and rabbit lymphocytes were treated with the mitogens, phytohemagglutinin (PHA) and concanavalin A (Con A) and lymphocyte DNA was labeled with ^{3}HTdR. The cultures were exposed to x and gamma radiation and velocity sedimentation patterns of lymphocyte DNA were obtained. Human lymphocytes treated with PHA did not recover from radiation damage during postirradiation incubation; rabbit lymphocytes treated with Con A not only did not recover but showed additional damage. The significance of the results is discussed. (HLW)

33405 (BNL-50418, pp 245-264) T-CELL SUBPOPULATIONS IN THE MOUSE. Kappler, J. W. (Univ. of Rochester, NY); Marrack, P. C.; Araneo, B.; Jacobs, D.; Lord, E. 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

Experiments were conducted to demonstrate the existence of T1 and T2 populations in the mouse. Other studies demonstrated differences in radiosensitivity of T-cell subpopulations. (HLW)

33406 (LA-UR-75-253) BIOLOGICAL EFFECTS OF THE LOS ALAMOS MESON BEAM ON CELLS IN CULTURE. Raju, M. R.; Dicello, J. F.; Trujillo, T. T.; Kligerman, M. M. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 17p. (CONF-741230-2). Dep. NTIS $4.00.

From Radiological Society of North American Conference; Chicago, Illinois, USA (1 Dec 1974).

Preliminary measurements of the biological effects of negative pions on cells in culture are reported. Cell survival as a function of depth was obtained by using gelatin to suspend the cells. The results indicate that the effects are more pronounced at the peak portion of negative pions. Cell-survival curves were also obtained under oxygenated and hypoxic conditions. The biological effectiveness at the peak was found to be a factor of 2.0 higher

than at the plateau. The oxygen enhancement ratio was 1.5 at the peak. No significant differences in biological effects were observed over 14 mm in the peak region. (auth)

33407 ULTRASTRUCTURE OF GLIAL CELLS IRRADIATED IN VITRO WITH GAMMA RAYS (^{60}Co). Ostenda, M. (Polska Akademia Nauk, Warsaw. Centrum Medycyny Doswiadczalnej i Klinicznej). Neuropatol. Pol.; 11: 405-410(1973). (In Polish).

Cultures of glial cells were irradiated with a one-time dose of 5000 R of gamma rays and thereafter were taken for electron-microscopic examinations in the period of 3 to 72 hrs after exposition. In the early periods after exposure (3 to 6 hrs) the Golgi apparatus showed an enhanced activity. In the cytoplasm, glycogen appears and the features of pinocytosis disappear. The symptoms retreat after 24 hrs. A parallel appearance of glycogen and reduction of pinocytosis are indicative of a transient impairment of the cellular metabolism. The increase in the later periods (72 hrs) of the number of secondary lysosomes, autophagosomes, and lipofuscine suggests the irreversibility of this impairment. The accumulation of glycogen in the impaired astrocytes in vitro indicates that this feature is independent on their nutritional and transporting functions. (auth)

33408 RADIOSENSITIVITY OF T AND B LYMPHOCYTES. P. 1. Effect of Irradiation on Cell Migration. Anderson, R. E. (New Mexico Univ., Albuquerque (USA). Dept. of Pathology); Sprent, J. (Basel Univ. (Switzerland). Inst. fuer Immunologie); Miller, J. F. A. P. (Walter and Eliza Hall Inst. of Medical Research, Parkville (Australia)). Eur. J. Immunol.; 4: No. 3, 199-203(Mar 1974).

To study the effect of irradiation on cell migration, populations of recirculating lymphocytes consisting predominantly of either T or B lymphocytes were labeled with ^{51}Cr, exposed to various doses of irradiation in vitro, and transferred intravenously to syngeneic mice. Cell recipients were killed at intervals to determine levels of radioactivity in various organs. On the basis of radioactive counts, small T lymphocytes homed normally to the lymphoid tissues within 4 h of injection (primary migration) in spite of prior exposure to heavy irradiation, e.g., 5,000 R. Primary migration, especially to the lymph nodes, was greatly reduced, however, when irradiated cells were cultured in vitro for 1 to 7 h before injection. This suggested that cell damage following irradiation was not manifested immediately, but developed slowly over several hours. This was supported by observations that, with cells injected immediately after irradiation, even doses as low as 50 R caused a marked reduction in secondary migration, i.e., migration occurring between 4 and 24 h after cell injection. Activated T cells proved to be more radioresistant than small T cells in that secondary migration of activated cells was not abolished, although reduced, by high doses of irradiation. B cells were found to be extremely radiosensitive. Thus, in contrast to T cells, primary migration of B cells was greatly reduced by heavy irradiation. Secondary migration of B cells, although limited, was abolished by 100 R. When lymphocytes were irradiated and placed in tissue culture for 4 days, virtually no B cells survived exposure to 300 R. This dose reduced viability of T cells by 90%. Five to 10% of T cells, however, remained viable after exposure to doses as high as 1,000 R. The results, as a whole, suggested that both T and B small lymphocytes die in interphase soon after irradiation, death occurring very rapidly with B cells, but less rapidly with T cells. Interphase death of activated T cells seemed to occur comparatively slowly. (auth)

33409 PROTECTIVE EFFECT OF SH COMPOUNDS ON THE RADIATION-INDUCED MITOTIC DELAY. II. Protective Mechanism of Glutathione. Kawasaki, S.; Kobayashi, M.; Okita, I.; Suetomi, K.; Sakurai, K. (Yamaguchi Univ., Ube (Japan). School of Medicine). Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 8, 599-604(Aug 1974). (In Japanese).

Effect of glutathione on the mitotic delay induced by x irradiation in cultured mammalian cells (L-5) was studied. When a random cell population was treated with various concentrations of glutathione 10, 20, 30, and 40 mM, mitotic index increased 5 to 8 hr. later and mitotic index decreased 10 to 14 hr. after the treatment. Glutathione (20 mM) was given at 6 hr., 3 hr., and 30 min. before and during irradiation of 200 rads. Its radioprotective effect was observed clearly when treatment was made at 3 hr. or 30 min. before and during irradiation, but treatment 6 hr. before exposure was not so effective. Post-treatment 6 hr., 3 hr., and 30 min. after irradiation with glutathione resulted in an enhancement of recovery rate of mitotic index but not a shortening of mitotic inhibition, but gave no effect on the mitotic delay time induced by x irradiation. On the basis of these data, the mechanisms of the radioprotective action of glutathione were discussed. (auth)

33410 PLOIDY EFFECT ON THE RADIATION REACTION OF MAMMALIAN CELLS. I. A New Tetraploid Chinese Hamster Cell Line. Bauer, A. (Technische Univ. Darmstadt (F.R. Germany). Fachgebiet Zoologie). Humangenetik; 23: No. 4, 289-296(1974). (In German).

A tetraploid substrain (B14F28/117) was isolated in a long period of treatment with Colcemide (60 days) from the diploid Chinese hamster cell line B14F28, cultivated in vitro. The single cells were isolated using small pieces of glass. The isolated substrain proved to be chromosomally stable. It was over 1.3 times more resistant to x rays than the diploid one. (auth)

33411 COMPARATIVE STUDY OF THE EFFECTS OF THE RADIOPROTECTIVE AGENT F-37 ON THE GENETIC EFFECTS OF X RAYS AND THE CHEMICAL MUTAGEN THIO-TEPA. Kukushkina, L. M.; Mase, I. B. (Inst. of Genetics and Cytology, Minsk). Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk; No. 2, 72-75(1975). (In Ukrainian).

The effects of the indene compound F-37 in concentrations of 0.001 mg/ml on the level of chromosome aberrations occuring in cells of cultures of human peripheral blood lymphocytes under the effects of x radiation at 100 R and the chemical mutagen thio-TEPA in concentrations of 10^{-4}M were studied. F-37 was introduced during the 30 minutes before the introduction of the mutagen to the lymphocytes. Under the effects of F-37 there was a sharp decrease of the percentage of radioinduced chromosome rearrangement in all stages of the mitotic cycles G_1, S, and G_2. The maximum protective effect was found in the G_1 stage and the percentage of chromosome rearrangements was reduced by a factor of 6. A less pronounced protective effect was found in the S and G_2 stages although the level of chromosome aberrations was reduced by a factor of 2.3. The introduction of F-37 to lymphocyte cultures before and after the introduction of the mutagen thio-TEPA does not affect the yield of chromosome aberrations. The high degree of protection from radioinduced rearrangements with the complete absence of effects in the case of the chemical mutagen is a strong confirmation of the proposed mechanism for the protective effects of indene compounds, which is based on the interception of radiation energy. (tr-auth)

Radiation Effects on Microorganisms

Refer also to abstracts 33373, 33380, 33381, 33383, 33387, 33388, 33395, 33396, 33487, 35701, and 35702.

33412 (JAERI-M-5610) SHALLOW IRRADIATION OF THE VIENNA SAUSAGE BY ELECTRON-RAYS IN PREVENTATION OF THE SLIME PRODUCTION. Watanabe, H.; Sunaga, H.; Kume, T.; Ito, H.; Aoki, S. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 18p. (In Japanese). INIS.

Vienna sausages get spoiled by slime production or putrefaction due to the propagation of microorganisms when stored only for 3 to 5 days at storage temperature 10°C. The radiation pasteurization for prevention of the slime production or putrefaction of vienna sausages was mainly studied with gamma irradiation. The slime of sausages is believed to be microorganisms themselves growing on the surface of sausages. Pasteurization of the surface of vienna sausages with electron irradiation was thus investigated. The vienna sausages irradiated to a dose of 0.8 to 1.0 Mrad with 0.5 MeV electrons could be stored without slime production or putrefaction for more than a week at 10°C. The effect of pasteurization increased with energy and dose of the electrons. Changes in the organoleptic qualities of vienna sausages were observable when irradiated to a dose of over 0.7 Mrad with 2.0 MeV electrons. Irradiation to a dose of 1.0 Mrad with 1.0 MeV electrons was effectual in lengthening their shelf-life without deterioration of the organoleptic qualities. (auth)

33413 (ORO-4568-2) ALTERATIONS INDUCED BY X-RAYS AND ULTRAVIOLET LIGHT ON THE SYNTHESIS AND MAINTENANCE OF MACROMOLECULAR COMPONENTS WITHIN CELLS. Progress Report, March 1, 1974–March 1, 1975. Billen, D. (Tennessee Univ., Knoxville (USA)). 1975. Contract AT(40-1)-4568. 9p. Dep. NTIS $4.00.

Results are reported from studies on B. subtilis and E. coli toluene-treated cells in which it was demonstrated that x-ray-induced repair synthesis, in which DNA polymerase I directed the synthesis, differs in several ways from DNA polymerase II- and III-directed repair synthesis. (CH)

33414 CHARACTERIZATION OF MUCOID MUTANTS OF ESCHERICHIA COLI K-12 ISOLATED AFTER EXPOSURE TO OZONE. Hamelin, C.; Chung, Y. S. (Univ. of Montreal). J. Bacteriol.; 122: No. 1, 19-24(Apr 1975).

Seventy mucoid mutants retaining the phenotypic properties of the ultraviolet-induced lon strains of Escherichia coli K-12 were isolated after treatment of strain MQ259 (lon^+) with ozone. They produce mucoid colonies at 37 C on minimal agar, are abnormally sensitive to radiation, and tend to grow in long

aseptate filaments after irradiation with ultraviolet light. Results indicate also that ozone sensitivity, radiosensitivity, and mucoidy are pleiotropic properties of the lon gene. (auth)

33415 ABSENCE OF REPAIR REPLICATION FOLLOWING ULTRAVIOLET IRRADIATION OF AN EXCISION-DEFICIENT MUTANT OF ESCHERICHIA COLI. Cooper, P. K.; Hanawalt, P. C. (Stanford Univ., CA). Contract AT(04-3)-326-7. Photochem. Photobiol.; 13: 83-85(1971).

Cultures of a K-12 strain of E. coli and the excision-deficient mutant were labeled with ^{32}P and exposed to uv radiation. Control and irradiated cultures received supplements of threonine, leucine, arginine, proline, histidine, and ^{3}H-labeled 5-BrU. Lysates were banded in CsCl equilibrium density gradients and collected fractions were assayed for ^{32}P and ^{3}H by liquid scintillation spectrometry. In both control and irradiated cultures, a large portion of newly-replicated DNA banded at a density intermediate between hybrid and normal. In the mutant strain, the apparent level of non-conservative replication decreased after irradiation. (HLW)

33416 SPECIFICITY OF ANTIBODIES TO THE MODIFIED DNA OF PHAGES SPO1 AND T4. Zamchuk, L. A.; Braude, N. A.; Gol'dfarb. (Inst. of General Genetics, Moscow). Mol. Biol. (USSR) (Engl. Transl.); 7: 592-597(Mar 1974).

Translated from Mol. Biol. (Moscow); 7: No. 5, 720-726(Sep 1973).

The immunogenic specificity of the DNA of phages SPO1 and T4, which contain anomalous nitrogen bases, changes as a result of the modification caused by methylene blue in the light or on uv irradiation. In the rabbit, the methylene-blue-modified SPO1-phage DNA induces the synthesis of antibodies to the ordinary nitrogen bases and to the changed guanine residues. When the DNA of phages SPO1 and T4 modified by uv light is used as antigens, antibodies to DNA containing the usual nitrogen bases are produced in the rabbit, but no antibodies to dimers of the pyrimidine bases can be detected. In the case of the SPO1 DNA, this is apparently connected with the fact that the 5-hydroxy-methyluracil, replacing thymine in it, is poorly dimerized. The immunogenic inertness of thymine dimers in the uv-modified T4 DNA is probably connected with the presence in it of glucosylated 5-hydroxymethylcytosine, which is the immunodominant antigenic determinant. Immunogenic activity of thymine dimers was shown only when the DNA of E. coli modified by uv light was used as the antigen. Thus, the functioning of the thymine dimers as an antigenic determinant depends on the structure of the DNA in which they are induced. (auth)

33417 BIOLOGICAL PROPERTIES OF ANTIGENS AND THE CHEMICAL PROPERTIES OF SPECIFIC POLYSACCHARIDES FROM BACTERIUM S. TYPHI EXPOSED TO GAMMA IRRADIATION. Shibaeva, I. V.; Izvekova, A. V.; Ivanov, K. K.; Tumanyan, M. A. (Inst. of Epidemiology and Microbiology, Moscow). Zh. Gig., Epidemiol., Mikrobiol. Immunol.; 17: No. 3, 332-337(1973). (In Russian).

The toxicity of radioantigens recovered from S. typhi bacteria that had been irradiated with doses of 0.6, 2.5, and 5 Mrads decreased with increasing radiation dose. The antigenic and immunological properties of the preparations of irradiated bacteria and the preventive properties of serum to radioantigens did not differ from those of preparations obtained from nonirradiated bacteria. The qualitative and quantitative properties of specific polysaccharides recovered from radioantigens were identical with those of preparations from nonirradiated bacteria, which indicates the comparatively high radiation resistance of the polysaccharide component of endotoxins in bacterial cells. (tr-auth)

33418 EFFECTS OF THERMAL AND RADIATION STERILIZATION ON SOME DYES APPLIED IN POLAND TO PHARMACEUTICALS. Wojcik, Z.; Szyszko, E. (Instytut Lekow, Warsaw (Poland)); Zagorski, Z. (Institute of Nuclear Research, Warsaw (Poland)). Acta Pol. Pharm.; 30: 519-526(1973). (In Polish).

For English translation see the journal Pol. Pharm. Trans.

Some synthetic dyes, applied to staining of pharmaceuticals sterilized at elevated temperature or by irradiation, were studied. When the pure dyes had been shown to be unaffected by either thermal and radiation sterilization, the stained dragee mass was sterilized under analogical conditions. The dyes were examined by alternating current oscilopolarography and thin layer chromatography. Decomposition of the dyes in the dragee mass was shown. (auth)

33419 CHARACTERIZATION OF MUCOID MUTANTS OF ESCHERICHIA COLI K-12 ISOLATED AFTER EXPOSURE TO OZONE. Hamelin, C.; Chung, Y. S. (Univ. of Montreal). J. Bacteriol.; 122: No. 1, 19-24(Apr 1975).

Seventy mucoid mutants retaining the phenotypic properties of the ultraviolet-induced lon strains of Escherichia coli K-12 were isolated after treatment of strain MQ259 (lon^+) with ozone. They produce mucoid colonies at 37 C on minimal agar, are abnormally sensitive to radiation, and tend to grow in long agar, are abnormally sensitive to radiation, and tend to grow in long aseptate filaments after irradiation with ultraviolet light. Results indicate also that ozone sensitivity, radiosensitivity, and mucoidy are pleiotropic properties of the lon gene. (auth)

33420 RADIOSTERILIZATION IN MEDICINE. Bochkarev, V. V.; Vashkov, V. I.; Pavlov, E. P.; Khruschev, V. G.; Ramkova, N. V. (Institut Biofiziki, Moscow (USSR)). Zh. Mikrobiol., Epidemiol. Immunobiol.; No. 8, 56-60(Aug 1973). (In Russian).

A discussion is presented on the use of ionizing radiation to sterilize instruments, bandages and various materials used in medicine. The selection of optimal radiation doses for radiation sterilization is discussed. As a result of investigating the radiation sensitivity of micro-organisms found in a number of hospital supply houses, effective radiation doses were determined. (tr-INIS)

33421 PROBLEMS IN RADIATION KILLING OF MICROORGANISMS. Matsuyama, A. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Radioisotopes (Tokyo); 22: No. 12, 724-736(Dec 1973). (In Japanese).

The radiation killing effect and its application are discussed. The death of microorganism cells indicating the formation ability of the visible colony and its evaluation method are stated and the target theory analyzed. The relationship between target injury in the cells due to radiation and the fatal effect is considered. Radiosensitivity of the microorganisms was compared by the necessary dose for 10% survival rate. The problems relating to microorganisms that have low radiosensitivity such as M. radiodurans and other problems are discussed. The results of the research until now on the loss of visible colony formation by irradiation, i.e. the killing effect, are summarized in order to know the differences of biological effect on microorganisms between various radiations. In addition, fatal injury from particle radiation is considered. Radappertization, radicidation, and radurization, and their application to foods, medical goods, etc., are also discussed. Safety and problems caused by environmental radiation are considered. (JA)

Radiation Effects on Plants

Refer also to abstract 35693.

33422 EFFECTS OF LATE NITROGEN FERTILIZATION ON DURUM WHEAT. Mosconi, C.; Bozzini, A. (CNEN, Casaccia, Italy). Riv. Agron.; 7: No. 2-3, 75-82(1973). (In Italian).

For five years, eight fertilizer trials were carried out in several localities of Lazio and Marche. The purpose of the trials was to ascertain the influence of early and late nitrogen applications on durum wheat yields and on the percentage of yellow berries. Three radioinduced mutant lines were used, i.e., "Castelporziano" and "Ga A7" characterized by short straw and resistance to lodging; "Ga A7" and "Rs A1" characterized by improved earliness compared to the mother line. Nitrogen, in calcium nitrate form, was always applied by broadcasting from January to May. The trial results revealed (although conducted in different places and years) a sufficiently homogeneous and clear response. Early nitrogen broadcasting (January to the first decade of March) mainly influenced yield, increased the number of spikes per unit area, and later on, the average number of flowers per spike. Since at the end of jointing, the differentiation of the spike primordia is complete, any broadcasting which follows this will only have noticeable effects on the degree of filling and on the chemical composition of the kernel. It has already been shown that mineral nitrogen must be available during the ripening process for a high storage protein synthesis and that high kernel content causes the kernel to be vitreous, and it can be concluded, therefore that any ecological or physiological condition which limits protein synthesis would increase the yellow berry phenomenon. (auth)

33423 EFFECTS OF IONIZING RADIATION ON ROSES WITH REFERENCE TO INDUCTION OF MUTATIONS. Sci. Cult. (Calcutta); 24: No. 6, 43-44(30 Mar 1974).

The effect of acute gamma irradiation on seven rose cultivars was studied. Observations made on plant growth, pollen fertility, time of flowering, abnormalities in leaves, etc. have been reported. The results obtained in the case of different specimens were compared and discussed. It was concluded that the induction, isolation, and multiplication of mutants in rose cultivars Pink Parfait and Quebec amply prove that gamma irradiation can be a very useful tool for plant improvement. (INIS)

33424 TRIALS WITH USING X RAYS IN SUGAR BEET BREEDING. Szota, Z. (Instytut Hodowli i Aklimatyzacji Roslin, Bydgoszcz (Poland). Zaklad Buraka i Innych Roslin Korzeniowych). Hodowla Rosl., Aklim. Nasien.; 17: 121-127(1973). (In Polish).

Dry seed, germinated seed, and young plants at the cotyledon

stage were given x-ray treatment. The tolerant dose for dry seed was found to be 30 to 40 kR, while that for germinated seed was 12 to 15 kR, and that for young plants was 8 kR respectively. The selection within the irradiated material did not result in obtaining of mutants that could be valuable both with regard to economic characters and the resistance to fungal diseases. It is likely that sugar beet breeders are in a position of improving sugar beet varieties without troublesome methods of mutation breeding as the mutability among the existing varieties is still great. (auth)

33425 STIMULATION OF YAM (DIOSCOREA) TUBER GROWTH BY GAMMA IRRADIATION. Martin, F. W. (Federal Dept. of Agriculture, Mayaguez, Puerto Rico); Koo, F. K. S.; Cuevas, J. Contract AT(40-1)-1883. J. Amer. Soc. Hort. Sci.; 99: No. 3, 282-284(May 1974).

Treatment of aerial tubers and underground tuber pieces of Dioscorea alata L., the 10-month yam, with about 1250 rads of gamma irradiation stimulated tuber germination, vegetative growth, and tuber yield. Higher dosages reduced viability and yields. When different parts of the tuber were irradiated, a slight yield stimulation occurred when the developing shoot was treated, but treatment of parts of the tuber reduced yield. Effects of irradiation disappeared entirely in the second vegetative generation after irradiation. (auth)

33426 CHARACTERISTICS OF THE MUTATIONS INDUCED FROM GAMMA-RAYED TEA PLANT UNDER HEAVY PRUNING TREATMENT. Nakayama, A. (Tea Research Station, Kanaya, Shizuoka (Japan)). Chagyo Gijutsu Kenkyu; No. 7, 29-35(Aug 1974). (In Japanese).

Twelve mutations concerning leaf shape, size, and color induced from semi-acute gamma irradiation have been reported. Leaf index (ratio of length to width of the leaf blade) of the original clone Z 1 and the mutant was 2.8 and 3.3, respectively. Large leaf mutant was 1.3 times larger in leaf size than the original variety. Pollen fertility of the variegated leaf mutant was only 36 to 67%. There appeared a mutant whose arginine content in the new tea shoot was twice that of the original variety "Yutakami-dori". There is a close correlation between the arginine content and the taste of green tea, therefore the above mutant is arousing the keen attention in paving the way for the breeding of high-quality variety. (auth)

33427 INDUCTION OF BUD MUTATIONS IN TEA PLANT UNDER CHRONIC IRRADIATION. Nakayama, A. (Tea Research Station, Kanaya, Shizuoka (Japan)); Nakajima, K.; Yamaguchi, I. Chagyo Gijutsu Kenkyu; No. 7, 16-27(Aug 1974). (In Japanese).

Induction of bud mutation in tea plants in the gamma field of the Institute of Radiation Breeding and some factors affecting the induction of mutation have been investigated since 1962. Bud mutations concerning leaf color were detected on the plants located between 22 and 55 m from the radiation source, 2 years after planting. The rate of the mutation was highest in the plants at the exposure rate of 20 to 30 R/day. Such mutations occurring under chronic irradiation appeared in the parts of plant that grew after the first growing period of the year, that is, in summer shoots. The tea plant frequently has branches with two or more growing periods. Namely, after the termination of the first growing period, the summer shoot begins to grow from the terminal buds of the first flush shoots, that is, spring shoots. However, spring shoots lacking the terminal buds occurred frequently in the tea plants at the exposure rate of more than 20 R/day. The summer shoots from such spring shoots grew originally from the upper axillary buds. Most of the mutated shoots were seen on such summer shoots. Usually, the number of differentiated leaves in the winter bud is closely related to that of leaves expanded in spring. In the tea plant under chronic irradiation, the number of leaves both in the winter bud and in the spring shoot evidently decreased with the increasing exposure rate. This indicates that the apical meristem of the winter bud is damaged by the gamma ray irradiation. The radiation damage in winter bud was confirmed histologically. However, the differentiation of new axillary bud was hardly developing in the axillary region just below the damaged apical meristem. (auth)

33428 EFFECT OF THE HEAVY PRUNING TREATMENT ON THE INDUCTION OF BUD MUTATIONS IN GAMMA-RAYED TEA PLANT. Nakajima, K. (Sericultural Experiment Station, Tokyo (Japan)); Nakayama, A.; Takato, S.; Tomo, N.; Yamaguchi, I. Chagyo Gijutsu Kenkyu; No. 7, 1-9(Aug 1974). (In Japanese).

Effects of heavy pruning on the induction of bud mutations in the tea plant by semi-acute gamma irradiation were investigated. The plants were subjected to the radiation of 2.5 KR or 5 KR, and the frequencies and spectra of mutations were compared between the plants irradiated before and after pruning. The frequency of the latter was found to be somewhat higher. The mutation rate per plant averaged 20 to 25%. The kinds of mutation covered a wide range of elongated, small, large, yellow and variegated leaf. Complex types of mutation were also observed. From the results obtained, it was concluded that the heavy pruning treatment for the induction of somatic mutations by semi-acute gamma irradiation on tea plant should be done by March, and that the irradiation of 2.5 to 5 KR after the pruning was effective. (auth)

33429 RADIOSENSITIVITY OF THE TEA PLANT UNDER CHRONIC GAMMA IRRADIATION IN A GAMMA FIELD. Nakayama, A.; Tomo, N.; Mitsui, M. (Tea Research Station, Kanaya, Shizuoka (Japan)); Nakajima, K. Chagyo Gijutsu Kenkyu; No. 7, 11-15(Aug 1974). (In Japanese).

Two- or three-year-old tea plants were planted in the Institute of Radiation Breeding at distances of 11.5 to 98.5m from the radiation source, in April 1962, in order to obtain the basic information for the induction of the somatic mutation by chronic irradiation. In the irradiated tea plants, asymmetric, bifurcated, elongated and other abnormal leaves were observed, and the frequency of occurrence of such leaves increased with the exposure rate. The height of the tea plants decreased in accordance with the increase of exposure rate. The lethal exposure and exposure rate for these tea plants seemed to be 60 to 80 KR and 60 to 80 R/day in the third year after planting, respectively. The rooting possibility of the cuttings obtained from shoots grown under chronic irradiation was tested. The shoots were gathered from various planting rows in the gamma field, and the cuttings were planted in the greenhouse. At one year after planting, the survival ratio of the cuttings originated from the plants grown at exposure rates of more than 40 R/day was only 50%. However, over 70% of the cuttings originated from the exposure rate of below 30 R/day survived. (auth)

33430 GENETIC DAMAGE AND ITS REPAIR IN HIGHER PLANT. Yamaguchi, H. (Tokyo Univ. (Japan). Faculty of Agriculture). Tanpakushitsu Kakusan Koso; 19: No. 8, 625-636(Aug 1974). (In Japanese).

A linear relationship was found to exist between frequencies of normal type mutation and irradiation doses in rice plants, and this relationship was 2-hit type in part-unbalanced type, which showed high radiosensitivity. The same phenomenon was seen in soy beans. In Shin-Mejiro of radiosensitivity, mutation frequencies increased at over irradiation doses to the first power, but in Tachisuzu-Nari of radioresistance, it seemed that mutation frequencies rather increased linearly with irradiation doses. These suggest that it is necessary to consider radiation injuries of a repair system that is working efficiently. Naito et al. observed that the ratio of membrane bound ribosome to free ribosome decreased linearly with increase of irradiation doses. As genetic damage and its repair are controlled by genes in higher plants, it must be promoted to analyze repair system by finding out the kind and the strain of radiosensitivity. It is good that there is variety in repair system because living things have been coming into existence in keeping interrelation with each other by combining genes variously in the process of evolution. (JA)

33431 MODIFICATION OF THE RADIATION DAMAGE OF POLYPLOID SERIES OF WHEAT BY CAFFEINE. Avakyan, V. A.; Muradyan, A. A. (Lab. of Induced Mutagenesis of Plants, Erevan). Dokl. Akad. Nauk Arm. SSR; 58: No. 5, 294-298(1974). (In Russian).

The differences in the radiosensitivity of polyploid series of wheat during inhibition by caffeine were studied. The seeds were irradiated with x rays at a dose rate of 260 R/min to a total dose of 10 kR. Some of the seeds were then soaked in caffeine solutions. The germination of the seeds, inhibition of growth, length of the primary root, and total length and quantity of all roots were the factors used in the evaluation of the radiation effects and caffeine inhibition. The results showed that caffeine acts as a reparation inhibitor by two mechanisms: interaction with ferments and interaction with parts of the DNA. The data obtained on the radiation damage showed that the tetraploid and hexaploid strains were more resistant to damage to the genetic apparatus than the diploid. (JSR)

33432 THE ISOLATION AND FIXATION OF WHOLLY MUTANT PLANT FROM SECTORIAL CHIMERA INDUCED BY GAMMA IRRADIATION IN BEGONIA REX. Matsubara, H.; Shigematsu, K.; Suda, H. (Tokyo Metropolitan Isotope Research Center (Japan)). Engei Gakkai Zasshi; 43: No. 1, 63-68(Jun 1974). (In Japanese).

A possibility of the application of the pruning techniques for the isolation, fixation, and propagation of wholly mutant plant from a small sectorial mutation induced by gamma irradiation on Begonia rex was investigated. Among irradiated Begonia plants, of the variety "Winter Queen", partially changed plants each having a small green chimeric mutation with a number of small silverwhite spots on leaf were found and one of these plants was employed throughout the present experiments. For extending and fixing the mutation, this plant was subjected to

repeated cutting-back, layering, and division in order to accelerate the development of axillary or adventitious buds and to grow them up to the shoots having the wider mutated area. After the application of these techniques, the wholly mutated shoot was finally obtained. This changed shoot was layered and grown to the wholly changed plant. The leaf color of new plants was green with a number of small silver-white spots as that of the original small sector. From this investigation, it is suggested that the combination of irradiation and various pruning techniques can be useful in the breeding of horticultural crops, which are propagated vegetatively, under ordinary cultural conditions. (auth)

33433 RADIATION INDUCED INTERSPECIFIC GENE TRANSFERS IN GENUS NICOTIANA. Niwa, M.; Murase, T. (Tokyo Univ. (Japan). Faculty of Agriculture). Gamma Field Symp.; No. 10, 41-58(Mar 1973).

Induction of the interspecific gene transfer by radiation was tried in a derivative line of species hybrid in the genus Nicotiana, in which one of N. plumbaginifolia chromosomes was added to the complement of N. tabacum (n = 24). The flower buds of the plants were irradiated by 1.2 kR of gamma rays, then they were crossed with nonirradiated plants for 14 days after the irradiation. Self green plants were selected from the progeny population and their meiotic configuration was tested. It was estimated that 16.6% of dominant gene Ws(pbg)'s originating from the irradiated male parents were translocated to tabacum chromosome, while 6.4% of those from the irradiated female parents were. The flower buds of the plants were also irradiated by 1.1 kR of x rays, then crossed with the nonirradiated plants for 14 days after the irradiation. Segregation for leaf color in the next generation was tested for each of the populations yielded from the crosses conducted on different days. Those times of irradiation, resulting in low frequency of self green seedlings, corresponded to the times of meiosis in PMC, the first mitosis in microspore and meiosis in EMC respectively, suggesting that irradiation at the time of the nucleus division during gametogenesis is less effective in translocating Ws(pbg) gene than the irradiation at the interphase. Soaked seeds obtained from the self pollination of a mottling plant were irradiated using 5 kR of x rays. The test of meiotic configuration and the segregation for leaf color in the next generation revealed that the disappearance of mottling on the leaves of X_1 plants was due to the translocation of Ws(pbg) gene to tabacum chromosome. Soaked seeds of tobacco were irradiated by 5-40 kR of x rays, then half of them were centrifuged. The post irradiation centrifuge increased the frequency of the plants developing self green sectors and/or leaves, suggesting that the postirradiation centrifuge enhanced the interspecific translocation of Ws (pbg) gene. The enhancement of the translocation was not accompanied by the decrease of the transmission rate of the translocated Ws(pbg) gene through gametes. (auth)

33434 CHARACTERISTICS OF TETRAPLOID TEA INDUCED FROM GAMMA-IRRADIATED YABUKITA VARIETY. Amma, S. (Tea Research Station, Kanaya, Shizuoka (Japan)). Chagyo Gijutsu Kenkyu; No. 46, 1-6(Jan 1974). (In Japanese).

The clonal tea variety Yabukita was irradiated chronically with cobalt-60 gamma rays in the gamma field of National Institute of Radiation Breeding. Tetraploid shoots were found among shoots grown from the tea plant irradiated at 17.9 kR. Several physiological and morphological characters, and chemical components of the tetraploid were compared with the original variety. There was no difference between the sprouting time of the tetraploid and that of the original one. The tetraploid shoot had greater stem with shorter node, and the growth of the tetraploid cutting was inferior to that of the original one. Mature leaves of the tetraploid were broader and rounder in shape than those of the original one. First palisade parenchyma, spongy parenchyma and leaf became thicker. The stomata of tetraploid were about 30% larger and the distribution density was significantly lower. The tetraploid plant had also heavier flower bigger ovary, thicker filament and wider petal than those of the original one, but the number of filaments and petals was unchanged. The tetraploid had higher sterility and larger pollen grains, and germination percentage and pollen tube growth were significantly inferior to those of the original one. Decreasing in the tannin content, and increasing in the total nitrogen and amino acid in the plucked shoots of first plucking season were observed. Ratios of theanine and serine to the total amino acid increased and those of arginine, glutamic acid and asparaginic acid decreased. (auth)

33435 RADIOBIOLOGIYA I GENETIKA ARABIDOPSISA. Tom 27. (Radiobiology and Genetics of Arabidopsis. Volume 27). Problemy Kosmicheskoi Biologii. Moscow; Izdatel'stvo Nauka (1974). 191p.

General characteristics are presented for the cruciform plant Arabidopsis, a new and promising object of research in the field of radiobiology, genetics, and space biology. A presentation is made of methods of the laboratory study of Arabidopsis, which include methods of culturing the plants, and methods of developing and quantitatively counting mutations. A method is developed for establishing the relation between the effects of the mutation process and the number of mutations occurring in nuclear meristem cells. A presentation is made of the somatic and genetic effects of irradiating Arabidopsis, and the effects of the physiological state of the seed, postradiation storage, thermal shock, and LET radiation. The mutual relations between various manifestations of radiation damage in the plants are analyzed quantitatively. (300 references) (SJR)

Radiation Effects on Animals

Refer also to abstract 35692.

Man

Refer also to abstracts 33124, 33362, 33403, 33409, 33631, 35036, 35044, 35652, and 35670.

33436 (AD/A-001026) CRITERIA FOR PERSONAL DOSIMETRY IN MIXED RADIATION FIELDS IN SPACE. Schaefer, H. J. (Naval Aerospace Medical Research Lab., Pensacola, Fla. (USA)). 16 Sep 1974. 20p. (NAMRL-1208). NTIS $3.25.

As manned space missions are becoming routine operations, the complex arsenal of instruments for personal radiation monitoring ought to be simplified. The necessary compromises concerning accuracy and completeness of record should be carefully evaluated. The report analyzes the dosimetrically relevant parameters of the three main contributions to the astronaut's radiation exposure in space: trapped protons, tissue disintegration stars, and neutrons. It is shown that interference and superposition effects from different components impose certain principal limitations on resolution. Possible ways and means for a system of restricted dosimetry which would record only certain parameters and establish the total dose equivalent from known characteristics of the radiation field are discussed. (GRA)

33437 (AED-CONF-74-509-019) MONTE CARLO CALCULATIONS OF A COLLIMATOR FOR FAST NEUTRON THERAPY. Schlegel, D.; Dietze, G. (Physikalisch-Technische Bundesanstalt, Braunschweig (F. R. Germany)). 1974. 11p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974). With abstract.

In neutron therapy of tumors, the normal tissue surrounding the tumor must be protected from damage by neutrons. Usually a collimator must be used to keep the neutron beam as narrow as necessary. A Monte Carlo program is presented which computes neutron spectra near the exit of such a collimator. The neutron source is assumed to be a point source which emits monoenergetic neutrons. The basic assumptions on the collimator geometry are shown. Several results using 14 MeV neutrons and various geometrical collimator configurations are discussed. (auth)

33438 (AED-CONF-74-509-020) SPECIAL INHOMOGENEITY EFFECTS FOR NEUTRON IRRADIATION OF THE LUNG AND HEAD. Boehm, J. K.; Hehn, G.; Kramer, H.; Pfister, G.; Prillinger, G.; Stiller, P. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). 1974. 6p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974). With abstract.

For a 14-MeV neutron therapy facility the effects of inhomogeneities occurring in real irradiation of the lung and head were studied in detail with the computer. The main calculation methods applied were the S_N-approximation and the Monte Carlo method. Neutron fields with beams of circular and rectangular cross sections were taken into account. The influence of different material layers with different atomic composition and densities on the neutron field were studied and compared with the results of the homogeneous phantom and ^{60}Co dose curves. The comparison was done with the absorbed dose showing the relative differences in the mainly perturbed regions within and outside the inhomogeneity. (GE)

33439 (BNL-50418, pp 23-29) TUMOR IMMUNITY: SOME IMPLICATIONS OF IN VITRO STUDIES ON LYMPHOCYTE-MEDICATED REACTIVITY TO ANIMAL AND HUMAN NEOPLASMS. Hellstroem, I.; Hellstroem, K. E. (Univ. of Washington, Seattle). 1974.

From interaction of radiation and host immune defense mecha-

nisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

Lymphocytes from animals and human patients with tumor can destroy cultivated cells from the respective neoplasms. Antigen-antibody complexes, and also free antigens, circulating in the blood stream and present in greater concentrations in the environment of the growing tumor, can block (abrogate) the lymphocyte-mediated cytotoxic reactions. These findings are likely to have ultimate usefulness for monitoring human cancer patients. Clinical procedures capable of increasing lymphocyte-mediated antitumor reactivity and, at the same time, decreasing the blocking ability of tumor antigen-antibody complexes (as well as free antigen), might be therapeutically useful. They may be so irrespective of whether the changes in the in vitro parameters are induced by performing surgery, radiation, or chemotherapy, or by giving some form of immunotherapy. (auth)

33440 (BNL-50418, pp 75-80) IMMUNE COMPETENCE IN THE PATHOGENESIS AND COURSE OF MALIGNANCY IN MAN: A SUMMARY. Israel, L. (Univ., Paris). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

Studies on immune competence are reviewed with regard to: nonspecific immunosuppression in cancer; relation of immunity to prognosis; role of primary immunodeficiency; immunosuppressive role of tumors; immunosuppression induced by surgery and radiotherapy. (HLW)

33441 (BNL-50418, pp 282-292) CONSTRAINTS OF NONSPECIFIC IMMUNOSTIMULATION. Israel, L. (Univ., Paris). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

Nonspecific immunostimulation is defined as a process by which the host response against a given antigen is triggered or enhanced by agents other than the specific antigen. Factors responsible for the impairment of the nonspecific immune functions are discussed. Depletion of T-cells and B-cells is caused by prolonged radiotherapy to the thymus area; it is not known whether this is detrimental or beneficial to the patient. (HLW)

33442 (BNL-50418, pp 314-322) BCG THERAPY OF MALIGNANCIES. Sparks, F. C.; Eilber, F. R.; Holmes, E. C.; Morton, D. L. (Univ. of California, Los Angeles). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

Immunosuppression that follows chemotherapy or radiotherapy may be prevented by immunotherapy. Experiments were conducted with rats and mice to define potential benefits as well as adverse side effects of immunotherapy. Results indicate that immunotherapy alone or in combination with radiotherapy or chemotherapy may be of value in treating human tumors. (HLW)

33443 (BNL-50418, pp 346-362) ROLE OF TUMOR ANTIGENICITY IN THE RESPONSIVENESS TO X-RAY THERAPY. Byfield, J. E. (Harbor General Hospital, Torrance, CA); Lagasse, L. D.; Weintraub, I.; Smith, M. L. 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

Cell cultures from patients with squamous cell carcinoma of the cervix were used as target cell cultures. Lethal damage was measured by colony inhibition tests. Characteristics of the cells were studied following radiotherapy. A table is presented to show cytotoxicity against cervical cancer target cells from patients before, during, and after x-ray therapy for cervical cancer. Evidence was obtained for specific tumor-related cellular immunity in radioresponsive cancers. (HLW)

33444 (HASL-291, pp I.19-I.37) TOXICITY OF THE TRANSURANIUM ELEMENTS WITH SPECIAL EMPHASIS ON PLUTONIUM. Stannard, J. N. (Univ. of Rochester, NY). 1 Apr 1975.

In Health and Safety Laboratory environmental quarterly, December 1, 1974–March 1, 1975.

Biological effects of the transuranic elements reside primarily in their emission of alpha particles during radioactive decay. A component of chemical toxicity cannot be excluded categorically but is difficult to demonstrate independent of radiation effects. The information on plutonium exceeds by far that for the other transuranics and much must be inferred by analogy from plutonium to the others. But there are significant differences in metabolic behavior among the nuclides and thus in the relative importance of effects in different organ systems, particularly in the relative involvement of soft tissues. The transplutonics seem in general to be more mobile and thus more likely to irradiate soft tissues instead of bone. At the low doses of interest in radiation protection, the chief concern is the development of cancer. For many years interest focused primarily on bone cancer in the case of plutonium but it now appears that the risk of cancer may be almost equally divided between lung, liver, and bone under certain conditions. This may be even more likely with the transplutonics. The chance of long-term genetic effects from deposition of transuranics in higher animals has usually been considered negligible. However it cannot be ignored completely until the accumulated information on gonadal content has been fully analyzed and preferably some actual experiments completed. (auth)

33445 (ORNL-5016, p 9) RADIOLOGICAL ASSESSMENT OF PLUTONIUM AND RECYCLE HTGR FUEL. Till, J. E. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

The relative radiological toxicities of environmentally released recycle ^{233}U HTGR fuel and LMFBR plutonium fuel are compared. This comparison was made using computer codes developed by the Radiological Applications and Analyses Group and assuming that isotopic release rates were proportional to known composition of each fuel. Only the relative magnitude of the dose is significant; however, hypothetical values were used for fuel concentrations. A U-fuel/Pu-fuel dose ratio was calculated to provide an index for relative hazard comparison. This study demonstrates the need to consider U fuel made from recycle ^{233}U and containing small amounts of ^{232}U as a potentially hazardous radiotoxicant. Uranium fuel using ^{238}U enriched with ^{235}U is considered a chemical toxicant, and radiation exposures from inhalation or ingestion of this fuel are not as harmful as the biochemical effects. This study also exemplifies the practicality and necessity of environmental transport models and dose calculation codes to evaluate potentially dangerous nuclear materials. (auth)

33446 (ORO-4257-3) CHEST FLUOROSCOPY AND NEOPLASIA IN TUBERCULOSIS PATIENTS: A RETROSPECTIVE SURVEY. Progress Report, 1973–1974. Battigelli, M. C. (North Carolina Univ., Chapel Hill (USA). School of Medicine). 1974. Contract AT(40-1)-4257. 12p. Dep. NTIS $4.00.

The program began with a verification of medical records concerning patients treated with collapse therapy. Following this survey, a pilot study was conducted involving 100 patients who had received either pneumothorax or pneumoperitoneum therapy. The methods used in the survey and pilot study including medical record verification, patient selection, control population selection, and optical data scanning procedures are briefly discussed. (ERB)

33447 (PB-236947) ESOPHAGEAL CANCER RECURRENCE AFTER RADIATION THERAPY. Smagulov, A. S.; Zhakenov, K. Zh.; Balmukhanov, S. B.; Turganbaev, A. T.; Abdrakhmanov, Zh. N. Translated from Vop. Onkol.; 19: No. 12, 9-14(1973). 10p. NTIS $3.25.

X-ray radiological semeiotics and certain features of recurrences of esophageal cancer after radiation therapy were studied in 400 patients, of which 335 were subjected to radiation and 65 to combined chemoradiation therapy. Clinical results showed complete disappearance of signs of the disease in 157 patients and considerable improvement in 191 patients. Thirty-seven patients in which a clinical cure was achieved showed recurring symptoms of the tumor; 19 during first year, 10 during the second year, and 8 after 3 years and later. It was shown that the method of treatment and the method of fractional doses also played a definite part in the recurrence of the disease. Thus, recurrences were observed most frequently with the usual method of fractional radiation therapy and less often with large fractional doses. Various morphological forms of the recurrent tumor showed some specific x-ray radiological manifestations. (GRA)

33448 (PB-237272) AUTOMATED RECOGNITION OF IRRADIATED CHROMOSOME IMAGES. Aggarwal, R. K.; Fu, K. S. (Purdue Univ., Lafayette, Ind. (USA). School of Electrical Engineering). Sep 1974. 168p. NTIS $6.25.

The problem of monitoring health related radiation damage is an important one for future and a system to detect chromosomal aberrations associated with radiation is extremely useful for monitoring populations at risk. In general, the most useful indicator of radiation damage at cell level is the occurrence of ring,

dicentric, fragment, and ring fragment chromosomes. The skeleton transformation is used for describing shapes of these chromosomes. A cutoff level independent skeletonization technique is proposed, discussed, and compared against Kilditch's and Montanari's techniques for obtaining a skeleton from a digitized grey level picture. An automated system using this approach for recognizing irradiated chromosomes is described in this dissertation. The test results of the system on 25 irradiated cells are included. (GRA)

33449 (REG/G-813(3-75)) INSTRUCTION CONCERNING PRENATAL RADIATION EXPOSURE. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Mar 1975. 4p. NRC.

Occupational exposures to radiation are being kept low. However, qualified scientists have recommended that the radiation dose to a pregnant woman should not exceed 0.5 rem because of possible risks to her unborn child. Since this 0.5 rem is lower than the dose generally permitted to adult workers, women may want to take special actions to avoid receiving higher exposures, just as they might stop smoking during pregnancy or might climb stairs more carefully to reduce possible risks to their unborn children. (auth)

33450 (SAAS-170) RADIATION PROTECTION IN PEDIATRIC X-RAY DIAGNOSTICS IN THE GDR. Koenig, W.; Menzel, B.; Friedrich, H.; Taschner, P. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Nov 1974. 64p. (In German). Dep. NTIS $6.25.

The paper presents results and conclusions from an examination performed from 1970 through 1972 with regard to radiation protection in pediatric x-ray diagnostics in the GDR. The following criteria were employed: constructional conditions, x-ray equipments, responsibility in radiation protection, medical responsibility, methods of examination, protective means, aerial dose measurements, radiation protection supervision of personnel, and measuring instruments. (auth)

33451 AETIOLOGICAL CONSIDERATION OF THYROID CARCINOMA. Doniach, I. Monogr. Neoplast. Dis. Various Sites; 6: 55-72(1970).

Possible factors in the causation of thyroid cancer have come to light through epidemiological surveys, clinical search for antecedent factors and pathological and experimental investigations. Carcinoma of the thyroid is not a single entity. The subgroups of papillary, follicular, medullary, and anaplastic thyroid carcinomas each present as separate clinico-pathological entities and are thus likely to originate by different mechanisms. The following antecedent factors are discussed: endemic goitre and sporadic nodular goitre, ionizing radiation, autoimmune thyroiditis, primary hyperthyroidism, congenital dyshormonogenesis, reparative and other types of thyroid growth, and the age factor. (auth)

33452 COMPARATIVE STUDY OF RADIATION DOSES RECEIVED DURING EXAMINATIONS WITH THE PANTOMOGRAPH, ORTHOPANTOMOGRAPH, PANOREX, STATUS-X, AND CONVENTIONAL ROENTGEN APPARATUS. Altonen, M.; Heikkila, M.; Mattila, K. (Univ., Helsinki). Proc. Finn. Dent. Soc.; 70: 67-74(Apr 1974).

A study was made of the radiation doses delivered to the skin of the head and neck, the rotational axes and certain roentgensensitive organs in a single exposure with the roentgenographic machines mentioned in the title. The exposure values used were those typically employed in maxillofacial radiographic diagnostics. The Machlett Alderson Rando phantom was used in all the tests and the dosimeters were plastic capsules filled with $Li_2B_4O_7:Mn$ thermoluminescent powder. The same reading device was used for all the results. The maximum radiation dose, 2589 mrad, was measured when Status-X equipment was used, registered by a dosimeter placed in the palate above the focus. When slit roentgenographic methods and the Status-X device were used, the radiation delivered to the front facial area was slight. The maximum eye dose, 70 mrad, was measured in a conventional lateral exposure. The maximum axial doses delivered by the orthopantomograph and the Panorex were 965 mrad and 682 mrad respectively, and were measured on the lateral rotational axes; the maximum value on the single rotational axis of the Pantomograph was 365 mrad. The highest dose recorded for the hypophysis, 360 mrad, was received from the Pantomograph. The dose diminished both upwards and downwards from the central ray of the beam. The largest skin doses were measured on the neck below angle of the mandible, 476 mrad, being delivered by the Orthopantomograph and 417 mrad by the Panorex. The plexiglass shield of the Orthopantomograph absorbed approximately 20% of the radiation. (auth)

33453 RADIOBIOLOGY OF LYMPHOCYTES. I. Synthesis of DNA in Lymphocytes Irradiated With Ionizing Radiation. Castellani, A. (CNEN, Cassaccia, Italy); Sedati, P.; Belloni, P. Haematologica (Pavia); 58: 915-930(1973). (In Italian).

The effect of ionizing radiations on DNA synthesis of phytohemagglutinin (PHA)-stimulated human lymphocytes is reported. Studies on the kinetics of entry of stimulated lymphocytes in S phase show that from 24 to 36 hours after stimulation, the entry in S phase exhibit an exponential pattern. At 36 hours after stimulation the cells start to progress from S phase to G_2 phase. At any given time it is possible to know the cell distribution within the S phase, that is the number of cells in the initial, medium, or late S phase. Taking into account these results on the cell kinetics, our data demonstrate that: PHA-stimulated lymphocytes, irradiated with ionizing radiations while in S phase, show an inhibition of DNA synthesis. This effect is exponentially related to the dose up to 500 rad. The inhibition of DNA synthesis, measured immediately after the irradiation, is quantitatively different in relation to the position of the cells within the S phase at the time of irradiation. The inhibition of DNA synthesis progressively decreases in cells irradiated respectively at 29, 31, 33, and 35 hours after PHA stimulation. The interpretation of these results seems to indicate that the changes in radiosensitivity of PHA-stimulated lymphocytes is related to the metabolic state of the cells, probably with the synthesis of DNA polymerase and DNA lygase which controls the repair of radiation damage to DNA. (auth)

33454 UNSCHEDULED DNA SYNTHESIS IN RHEUMATOID AND EXPERIMENTALLY INDUCED ARTHRITIS. Tuschl, H.; Altmann, H. (Forschungszentrum, Seibersdorf, Austria). Arthritis Rheum.; No. 2335, 1-13(Sep 1974).

The capacity for the repair of lesions in the DNA after gamma and uv irradiation was investigated in lymphocytes of patients with rheumatoid arthritis (RA) and healthy controls by unscheduled DNA synthesis. Likewise the effect of mycoplasma- or adjuvans-induced arthritis on DNA repair was examined in rats. After gamma irradiation, a decrease in DNA repair was demonstrated with RA and mycoplasma induced arthritis, while repair was increased after uv irradiation. No effect on DNA repair was detected in adjuvans- induced arthritis. (auth)

33455 CHANGES IN THE INTESTINAL ABSORPTION OF CARBOHYDRATES AFTER VARYING APPLICATIONS OF RADIATIONS TO PORKERS AND AFTER ABDOMINAL IRRADIATION OF TUMOR PATIENTS. Neumeister, K.; Oelssner, W. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Radiologische Klinik); Koch, F.; Mehlhorn, G.; Panndorf, H.; Johannsen, U. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Tierproduktion und Veterinaermedizin). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 48-52 (1974). (In German).

Tumor patients and swine were exposed to varying doses of fractionated x irradiation. A dose-dependent decrease and increase of intestinal carbohydrate absorption was observed. As reasons for these variations were discussed: injuries of the small intestinal epithelium, changes in the duration of contact between nutrient and intestinal wall, and changes of intestinal blood circulation. (INIS)

33456 SURVEY OF PHARMACOLOGICAL EFFECTS OF THE RADIOPROTECTIVE DRUGS CYSTAMINE, AET, SEROTONIN, AND MEXAMINE. Kuna, P. Inf. Zpr. VLIS (Vojen. Lek. Inf. Sluzba).; 14: No. 3, 5-45([nd]). (In Czech).

Available from the Military Medical Information Centre, Hradec Kralove, Czechoslovakia.

Characteristics are discussed of the most efficient radioprotective substances, such as cystamine, AET, serotonin, and mexamine. Listed are the chemical characteristics, metabolism, effects on the entire physical conditions, on the central nervous system, and on the cardiovascular system, and also other possible effects of the drugs. (INIS)

33457 POSSIBLE APPLICATION OF NEW TRENDS IN THERAPY OF BONE MARROW SYNDROME OF ACUTE RADIATION DISEASE BY TRANSPLANTATION OF HAEMATOGENIC TISSUE CELLS. Petyrek, P. Inf. Zpr. VLIS (Vojen. Lek. Inf. Sluzba).; 14: No. 3, 47-104([nd]). (In Czech).

Available from the Military Medical Information Centre, Hradec Kralove, Czechoslovakia.

Based on an extensive list of references, a detailed review is presented of the characteristics of bone marrow cell transplantation and its application in the therapy of radiation disease. The role of the thymus and of lymphocytes is also discussed as are the immunological aspects of the therapy. (INIS)

33458 FREQUENCY AND IMPORTANCE OF LATE INTESTINAL REACTIONS AFTER CURATIVE RADIOTHERAPY IN FEMALE PATIENTS WITH COLUMN CARCINOMA AND MALE PATIENTS WITH TESTICLE TUMORS. Prager, W.; Taubert, W. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic).

Radiologische Klinik). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 83-87(1974). (In German).

Late intestinal reactions of x or ^{60}Co γ-irradiated male and female tumour patients were investigated. In ⅔ of patients the reactions appeared within the 1st year after irradiation and continued in ¾ of the patients for more than 2 years. There were no differences between x and ^{60}Co therapy. (INIS)

33459 CLINICAL ASPECTS OF RADIATION-INDUCED CHANGES OF TERMINAL PARTS OF THE COLON IN GYNAECOLOGICAL PATIENTS. Holtzhauer, R. (Friedrich-Schiller Univ. Jena (German Democratic Republic). Frauenklinik). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 92-94(1974). (In German).

The symptomatology and therapy of late intestinal radiation reactions in female tumor patients, who had been treated by radiotherapy, are described. (INIS)

33460 EARLY REACTIONS OF THE GASTROINTESTINAL TRACT AFTER ABDOMINAL IRRADIATION IN TUMOR PATIENTS. Neumeister, K.; Kamprad, F. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Radiologische Klinik). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 79-82(1974). (In German).

Intestinal disturbances and weight changes in irradiated female tumor patients were examined. When rectum and jejunum were irradiated, the part of patients with diarrhea was highest. Patients with manifest intestinal disturbances lost 3.8% of their weight, whereas patients without diarrhea lost 1.4% of body weight. Water loss, catabolic processes, and a radiation-induced resorption disturbance of the small intestine are discussed as causes for weight changes. (INIS)

33461 COMBINED MODALITY APPROACH TO THE TREATMENT OF HODGKIN'S DISEASE. Preliminary Results of a Prospectively Randomized Clinical Trial. O'Connell, M. J.; Wirnik, P. H.; Brace, K. C.; Byhardt, R. W.; Greene, W. H. (National Cancer Inst., Baltimore). Cancer; 35: No. 4, 1055-1065(Apr 1975).

Eighty-seven previously untreated patients with pathologic Stage IA, II (A or B), or IIIA Hodgkin's disease were randomized over a 48-month period to receive either megavoltage extended field radiotherapy alone or megavoltage radiotherapy limited to involved lymph node sites (including at least an upper mantle field) followed by combination chemotherapy with nitrogen mustard, vincristine, prednisone, and procarbazine (MOPP). Four patients (4.6%) failed to achieve remission with initial radiotherapy. Seventy-two evaluable patients have currently completed therapy. Ten of 41 patients achieving remission with radiation alone have relapsed, compared to only 1 of 31 receiving radiation plus chemotherapy. Seven patients have died, 3 of whom failed to achieve remission with initial radiotherapy. The other 4 had Stage IIIA disease treated with radiation alone. Severe myelosuppression occurred infrequently during chemotherapy, and neither serious infections nor second neoplasms have been observed. Although these preliminary results are encouraging, longer followup is required to determine the ultimate effects of combined modality therapy on survival and long-term complications. (auth)

33462 EFFICACY OF COMBINING RADIATION THERAPY WITH A SURGICAL PROCEDURE IN PATIENTS WITH CERVICAL METASTASIS FROM SQUAMOUS CANCER OF THE OROPHARYNX AND HYPOPHARYNX. Jesse, R. H.; Lindberg, R. D. (Univ. of Texas, Houston). Cancer; 35: No. 4, 1163-1166(Apr 1975).

To determine whether combining radiation therapy and a surgical procedure was superior to either modality alone, the authors reviewed the records of 345 patients who had primary cancers of the base of the tongue, tonsillar fossa, or pyriform sinus associated with clinically positive nodes at the time of their first observation. Combining the two modalities of therapy produced a local and regional control of the disease in twice as many patients as did one modality alone. The absolute 5-year survival did not reflect this same trend, however, since as local and regional control increased, more patients lived longer but died before five years from distant metastases. Immunochemotherapy is suggested as a possible adjunct therapy to prevent distant metastases. (auth)

33463 RADIATION ENTERITIS IN CHILDREN: A RETROSPECTIVE REVIEW, CLINICOPATHOLOGIC CORRELATION, AND DIETARY MANAGEMENT. Donaldson, S. S.; Jundt, S.; Ricour, C.; Sarrazin, D.; Lemerle, J.; Schweisguth, O. (Institut Gustave-Roussy, Villjuif, France). Cancer; 35: No. 4, 1167-1178(Apr 1975).

The clinicopathologic features of radiation enteritis are reviewed in 44 children receiving whole abdominal radiation therapy between 1961 and 1972 at the Institut Gustave-Roussy. Five of 14 long-term survivors (36%) developed severe delayed radiation injury with small bowel obstruction, occurring within 2 months after completion of irradiation. All had previously had acute radiation reaction during therapy. Histologic appearance in the small bowel at the time of delayed radiation injury revealed severe villus blunting, lymphatic dilatation, and moderately dense inflammatory infiltrate. All patients with delayed radiation injury showed marked clinical improvement coincident with a fractionated low-residue, low-fat diet, free of gluten and free of milk and milk products. The abnormal small bowel roentgenographs and small bowel biopsies reverted to a normal appearance in association with the diet. No exacerbation of radiation enteritis has been seen following dietary therapy. (auth)

33464 HYPOTHYROIDEA FOLLOWING ^{131}I TREATMENT OF BASEDOW'S DISEASES. Mori, T.; Konishi, J.; Ikekubo, K.; Endo, K.; Morita, R. (Kyoto Univ. (Japan). Faculty of Medicine). Nippon Rinsho; 32: No. 7, 2381-2386(Jul 1974). (In Japanese).

About 750 cases of Basedow's disease were treated by ^{131}I therapy from 1956 up to now, and their follow-up data were continuously collected by every 2 to 3 years. In 156 subjects who visited the hospital for followup examinations in 1971, 50 subjects (32.1%) showed hypothyroidea. These were administered the same dose of ^{131}I as that of the cured subjects. Hence the difference of sensitivity to ^{131}I by individuals was studied. As the results, histological findings in thyroid gland by needle biopsy, and levels of LATS and thyroid antibodies, i.e., proliferation of the follicular epithelium and LATS level, lymphocytic infiltration, and thyroglobulin antibody level, and fibrosis and microsome antibody level revealed close correlation. On the other hand, the cases of hypothyroidea following the primary ^{131}I treatment revealed high antibody titration of thyroid antibodies, especially that of thyroglobulin antibody, and in addition lymphocytic infiltration. The results of TSH measurements by T_3 resin sponge uptake and serum T_4 level in the followup subjects in 1971 showed high TSH levels not only in the subjects with hypothyroidea, but also some cured subjects with euthyroidism, with an average level of $17 \pm 23\ \mu$ U/ml. The results of measurements of TSH level in the above mentioned cured subjects 2 years later revealed four new cases of increased TSH level, and five cases of hypothyroidea which showed high TSH levels in the previous examination. From 1971, the ^{131}I dose in the primary treatment reduced to about 4 mCi in order to screen the individual sensitivity in our department, and moreover readministration of ^{131}I was avoided as possible. In the data of further 1 to 2 years course of 66 cases showed only two cases of hypothyroidea indicating that this method was effective prevention of hypothyroidea. In addition, healing by the first treatment was shown in 45 cases (68.2%) of favorable results, and healing including that by retreatment was 75.8%. (JA)

33465 EFFECTS OF DEXTRAN SULFURIC ESTER UPON THE RADIATION THERAPY IN THE CASES WITH UTERINE CANCER. Prevention from Subcutaneous Induration. Oshiumi, Y.; Shidahara, M. (Hiroshima Red Cross Hospital (Japan)); Nishitani, H.; Nakayama, T.; Koga, K. Rinsho Hoshasen; 19: No. 6, 463-471(Jun 1974). (In Japanese).

Subcutaneous induration was often seen, although wet change almost never occurred with ^{60}Co γ irradiation in the cases with malignant tumor. Internal administration of dextran sulfuric ester (MDS) was performed in the cases of uterine cancer with radiation therapy. In addition, the effects of dextran sulfuric acid ester was determined using a skin crytoradiometer. Six factors such as skin dose, irradiation method, combination method with Ra intracavital irradiation, wound due to operation, age and obesity coefficient were generally studied. As a result, the degree of hardness was 12.9 ± 2.8 g in the control group, 7.5 ± 3.0 g in the non-control group and 12.1 ± 2.3 g in the group with administration of MDS. MDS was extremely effective for the inhibition of the subcutaneous induration. (JA)

33466 DIARRHEA FOLLOWING WHOLE PELVIS IRRADIATION IN FEMALE PELVIC CANCER. Sakurai, T.; Moriya, H.; Hareyama, M.; Suzaki, K. (National Hospital of Sapporo (Japan)). Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 4, 205-211(Apr 1974). (In Japanese).

Diarrhea induced by acute intestinal disturbances, observed during radiotherapy of cancer of pelvic organs, was investigated in relation to (1) the dose delivered per fraction, (2) irradiation field, and (3) previous history of abdominal operation. In addition, a study was made as to whether delayed disturbances tend to occur in patients with severe diarrhea. Diarrhea was more severe in the group given 250 to 300 rads per day than in others. A difference was noted in the incidence of diarrhea between irradiation fields of 15×14 cm and 13×12 cm. No difference was noted in the incidence of diarrhea between patients with a previous history of abdominal operation and those without when the associated probability is 5% (while a significant difference was noted when the associated probability is 5 to 10%. No correlation was noted

between acute intestinal disturbances and delayed disturbances. (auth)

33467 RADIATION COMPARATIVE EXPERIMENTAL ZOOLOGY. Discussion of the Extrapolation of Data from Animals to Humans. Matsuoka, O. (National Inst. of Radiological Sciences, Chiba (Japan)). Genshiryoku Chosa Jiho; No. 2, 30-57(Oct 1973). (In Japanese).

Information generally accepted so far on the background for the extrapolation from experimental animals to humans is described. The information is considered from the standpoint of radiation comparative experimental zoology, radiation comparative physiology in particular, aimed at obtaining data on the extrapolation from experimental animals to man. The LD_{50}, differences in animals in the mode of death, changes in the sensitivity in the homogeneous animal species, and changes in radiosensitivity by age and sex distinction were examined. Establishment of the maximum permissible dose of ^{239}Pu and the relationship between recovery from radioinjury and the metabolic rate are mentioned as examples of extrapolation. The following 4 points were shown as the factors to be considered for extrapolation: (1) correspondence of stage and quantitative differences of life span and differences by age as time factors, (2) geometric factors, (3) the data on animals that should correspond to that on standard individuals and biological half life time of radioactive nuclides, as quantitative factors, and (4) differences in the metabolic system according to animal, the structure of organs, environments, genetic differences, and differences in eating habits and nutrition according to animal, as qualitative factors. The method of extrapolation is discussed from the correspondence of stage for extrapolation, correlation of metabolism in time, and differences in the metabolic process according to animal. (JA)

33468 RICHTLINIEN FUER DEN STRAHLENSCHUTZ BEI VERWENDUNG RADIOAKTIVER STOFFE IM MEDIZINISCHEN BEREICH. Strahlenschutz. (Radiation Protection Guidelines for the Application of Radioactive Substances in Medicine. Radiation Protection). Schriftenreihe des Bundesministeriums des Innern, Stuttgart, F. R. Germany; Kohlhammer (1974). 37p. (In German).

This edition arranges technical and legal specifications contained in the legal provisions and in the DIN standards according to systematic aspects: preconditions for the granting of licenses to use radioactive materials; transport; accident and loss; safety measures; application to patients (radiation therapy, nuclear medicine); measures for the protection of the environment; and radioactively contaminated bodies. These guidelines only complete the stipulations of the radiation protection ordinance and other standards. (GE)

33469 PLANNING OF RADIOLOGICAL DEPARTMENTS. Proceedings. Kormano, M. (ed.) (Turku Univ. (Finland). Diagnostic Radiology Dept.); Stieve, F. E. (ed.) (Bundesgesundheitsamt, Berlin (F. R. Germany). Abt. fuer Strahlenhygiene). Stuttgart, F. R. Germany; Thieme (1974). 417p.

From international symposium on the planning of radiological departments; Otaniemi, Finland (9 Aug 1972).

Papers in book form, are presented at the International Symposium "Planning of Radiological Departments" in Dipoli, Otaniemi (Finland), August 1972. (GE)

33470 CLINICAL NEUTRON THERAPY-EQUIPMENT WITH DT-GENERATORS (DYNAGEN). Hofmann, E. G. (Allgemeine Elektricitaets-Gesellschaft AEG Telefunken, Wedel/Holstein (F.R. Germany). Fachgebiet Sondertechnik). Strahlentherapie; 148: No. 5, 511-519(Nov 1974). (In German).

From symposium on trends of modern radiotherapy; Vienna, Austria (4 May 1974). 10 figs.; 1 tab.; 15 refs.

For the treatment of hypoxic or anoxic tumors, until now radioresistant, the use of high-LET radiation is suggested. For routine clinical work, fast neutrons are best suited, as they can be produced with far lower technical and financial expenditure than the π-mesons for instance. Of the neutron sources concerned, DT-generators in particular meet all the requirements of a 50% dose in a tissue depth of 10 cm, with sufficient intensity. The Dynagen equipment recently installed in the University Hospital Hamburg-Eppendorf works according to this principle. It is constructed according to clinical aspects, possesses a collimator and appliances for pendulum and arc irradiation; so it fully meets the special requirements of modern radiotherapy. Similar equipment, designed for the General Hospital in Vienna, is discussed. (auth)

33471 DOSIMETRY OF CALIFORNIUM-252 INTRACAVITARY APPLICATIONS BASED ON THE REVISED MANCHESTER SYSTEM. Iyer, P. S.; Nagarajan, P. S. (Bhabha Atomic Research Centre, Bombay (India). Radiological Protection Div.). Strahlentherapie; 148: No. 6, 564-570(Dec 1974).

The revised Manchester system of loading, in which the dose rates at point A and point B are of importance, is widely used for intracavitary applications. Because of lower oxygen enhancement ratio and absence of gaseous radioactive products, californium-252 is a promising substitute for radium in such applications. The amounts of californium required in each tube to produce biologically effective dose rates at point A, which are nearly equivalent to those from corresponding radium tubes, are estimated. The isoeffective dose distributions for any particular type of application are found to be similar for radium and californium in the volume of interest. (auth)

33472 IMPORTANCE OF VASCULARITY, TUMOR BED, AND OTHER GENERAL ASPECTS IN RADIOSENSITIVITY. Casarett, G. W. (Univ. of Rochester, NY). pp 181-202 of Biological and Clinical Basis of Radiosensitivity. Friedman, M. (ed.). Springfield, IL; Charles C. Thomas (1974).

Under consideration is the relative importance of the supporting tissues of tumors to the radiosensitivity of the parenchymal cells and tissues of organized tumors, and in the response of tumors to ionizing radiation, particularly in the context of radiotherapeutic practice. On this basis, only is radiosensitivity at the time of the first radiation exposure of concern, but also changes in radiosensitivity caused by each exposure in any of the schemes of fractionated exposure in radiotherapy. There are many variables that influence the initial radiosensitivity of tumors and the direction, the time and the degree of radiation-induced changes in radiosensitivity of tumors. Depending on the nature of the tumor and its response to irradiation, the size of the radiation dose fraction, and the time interval between dose fractions, some of these variables may act together to enhance the radiosensitivity of a tumor to particular dose fractions, or may oppose each other to offset their individual effects on radiosensitivity of the tumor, or may act together to depress the radiosensitivity of a tumor to particular dose fractions. At any particular time in the course of fractionated radiotherapy it is the net result of the influences of these many variable modifying factors which determines the direction and degree of change in radiosensitivity of the tumor to the next dose fraction. (auth)

33473 IATROGENIC EFFECTS IN RADIATION CARCINOGENESIS. Warren, S. pp 483-494 of Malignant Diseases in Children. Deeley, T. J. (ed.). London; Butterworths (1974).

It is clearly established that whole-body irradiation in childhood above 100 rads and perhaps above 50 rads as well as partial-body radiation in amounts of several hundred rads or more will induce an increased risk of leukemia. There is some evidence that exposure to intra-uterine radiation at low doses may increase the subsequent incidence of leukemia and other cancers, at dose levels of one to 10 rads or possibly even less. However, the evidence as to this is still contradictory, and the degree of risk remains to be determined. Irradiation of the thyroid in infancy or childhood, usually with several hundred R, increases the incidence of cancer of the thyroid; usually of papillary type. Heavy therapeutic radiation in childhood increases the risk of a variety of tumors developing in the irradiated site after long, latent periods, sometimes over 50 years. Although radiation-induced benign and malignant tumors occasionally appear subsequent to therapeutic doses of radiation and under special circumstances, as perhaps in amounts used for diagnosis, the benefits of diagnostic and therapeutic radiation usually outweigh the harm. However, the apparent susceptibility to radiation damage in prenatal stages and childhood warrants extreme care in such application. (auth)

33474 GLAUCOMA SECUNDARIUM FOLLOWING RADIATION THERAPY TO THE ORBIT. Yanagisawa, Y.; Takase, M.; Tsukahara, S. (Tokyo Univ. (Japan). Faculty of Medicine). Gann; 68: No. 9, 903-908(Sep 1974). (In Japanese).

Twenty four cases of malignant tumors in the orbit and adjacent region were treated by radiation therapy, and the exposure dose, intra-ocular pressure, out flow rate of the aqueous humor, intravenous pressure of the upper sclera, and the rigidity of the eye ball were studied and discussed. The cases in which 7,000 rads were given showed the decreased rate of the aqueous humor flow, the increased intravenous pressure of the upper sclera, and the frequent rises of the intra-ocular pressure. At the same time, the rigidity of the wall of the eye ball revealed to be decreasing. Histological observation revealed proliferation of the connective tissues in the gonoscopic region, and the increase of pigments and neovascularity in the trabecular meshwork. (JA)

33475 PROBLEMA KHIMICHESKOI ZASHCHITY V RADIATSIONNOI GENETIKE. (Problem of Chemical Protection in Radiation Genetics). Mosse, I. B. Minsk; Izdatel'stvo Nauka i Tekhnika (1974). 152p.

This monograph considers the pressing problem of protecting the genetic system of an organism from the harmful effects of ionizing radiation. A review is given of the most important studies in this field on protecting the hereditary structures of an organism

from radiation by administration of chemical agents. Possible mechanisms of this protection are considered, and a discussion is given of methods of searching for chemical substances which can protect the genetic system of an organism. (382 references) (SJR)

Vertebrates

Refer also to abstracts 33335, 33363, 33385, 33393, 33408, 33535, and 35691.

33476 (AD/A-000960) EFFECTS OF LOCAL SUPRALETHAL IRRADIATION ON RENAL FUNCTION. Buerkert, J. E.; Doyle, J. E.; Ewald, W. G. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). May 1974. 39p. (AFRRI-SR-74-8). NTIS $3.75.

Clearance studies were performed in 16 dogs with surgically formed hemibladders to evaluate the intrinsic renal effects of 2000 rads of x rays administered as a single dose to the left kidney. These studies were conducted under conditions of water diuresis in 10 dogs on days 1, 7, and 14 post-exposure. Results of the studies indicate that the earliest effects of radiation are related to the ability of the proximal tubule to reabsorb sodium and are manifested by both an increase in the fractional and absolute excretion of sodium within 24 hours of exposure, which continues throughout the interval of the study, and by a marked increase in the excretion of CH^2O within a day of exposure, which becomes greater with time. Approximately three weeks post-exposure, but before glomerular filtration rate declines, the concentrating segment of the nephron is impaired. These studies suggest that renal tubular injury is the major early effect of radiation. (GRA)

33477 (AD/A-000962) GAMMA-AMINOBUTYRIC ACID METABOLISM AND RADIATION-INDUCED SEIZURES. Zeman, G. H.; Chaput, R. L. (Armed Forces Radiobiology Research Inst., Bethesda, Md. (USA)). Jun 1974. 20p. (AFRRI-SR-74-11). NTIS $3.25.

Miniature swine convulsed spontaneously within 30 seconds after a 10,000-rad dose of 30 MeV electrons was delivered to the brain. The seizures ended 2 to 5 minutes later. Since alterations in gamma-aminobutyric acid (GABA) metabolism occur in and may be an underlying cause of a variety of convulsive disorders, regional brain concentrations of GABA and activities of L-glutamic acid decarboxylase (E.C.4.1.1.15) (GAD) were determined in control and irradiated miniature swine. The hypothalamus and midbrain had the highest GABA concentration and GAD activity, followed, in decreasing order of GABA concentration, by the caudate nucleus, thalamus, hippocampus, cerebral cortex and cerebellum. At four minutes after irradiation, GABA concentrations did not change significantly in any brain region examined; the largest apparent change was a decline from 2.31 ± .13 to 2.04 ± .11 μM/G wet weight in the thalamus. Concurrently, GAD activity in the thalamus increased significantly from 238 ± 7 to 315 ± 29 μM/H per G protein. (GRA)

33478 (AED-CONF-74-440-010) SYNCHRONIZATION OF THE WALKER CARCINOMA IN RATS BY MEANS OF IRRADIATION. Linden, W. A.; Zywietz, F.; Skiba, J. (Hamburg Univ. (F. R. Germany). Inst. fuer Biophysik und Strahlenbiologie). 1974. 5p. (In German). INIS.

From annual meeting of the Deutsche Physikalische Gesellschaft fuer Biophysik e.V.; Freiburg im Breisgau, F. R. Germany (2 Oct 1974).

The effect of x rays on the cell division cycle of the Walker carcinoma of the rat was investigated with the pulse cytophotometer. Analysis of the DNA histograms with a computer program showed that the irradiation partly synchronized the cells of the exponentially growing Walker carcinoma (tumor volume 1 cm^3). Following a radiation dose of 900 rad, about 50% of the tumor cells in the G_2 phase of the interphase were accumulated. An increase in the dosage to 1,200 rad led to no further increase in the degree of synchronization. The fractionation of the total dose (3 × 300 rad with an 8-hour interval) showed comparable results; a further increase was not observed. The application of this synchronization method is discussed with regard to the so-called synchronization therapy with steadily growing tumors. (GE)

33479 (BNL-50418) INTERACTION OF RADIATION AND HOST IMMUNE DEFENSE MECHANISMS IN MALIGNANCY, MARCH 23-27, 1974, WHITE SULPHUR SPRINGS, WEST VIRGINIA. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. 411p. (CONF-740331-). Dep. NTIS $10.60.

Separate abstracts were prepared for the 25 papers presented at the conference. (HLW)

For abstracts of individual papers see: 33400-33405, 33439-33443, 33480-33485, 33586, and 35678-35684.

33480 (BNL-50418, pp 81-93) POTENTIAL APPLICATIONS OF GRAFT-VERSUS-HOST REACTIONS TO TUMOR IMMUNOTHERAPY. Katz, D. H. (Harvard Medical School, Boston). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

The following studies are reviewed: development of specific tumor immunity resulting from immunization with sublethal tumor inocula, inactivated tumor cells, or tumor cell extracts; efficacy of utilizing immunization regimens in the nondiseased animal to induce specific immunity which will protect the animal against a subsequently administered tumor inoculum; irradiation of mice with leukemia or solid tumors prior to injection of allogeneic or xenogeneic lymphoid cells; and transplantation of bone marrow into terminal leukemia patients treated with x radiation or cyclophosphamide. (HLW)

33481 (BNL-50418, pp 152-166) PRIMARY AND SECONDARY ANTIBODY RESPONSES RELATED TO RADIATION EXPOSURES. Stoner, R. D. (Brookhaven National Lab., Upton, NY); Hess, M. W.; Terres, G. 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

Mice were exposed to x and gamma radiation and proton beams. Antibody responses were elicited with injections of tetanus toxoid in soluble, absorbed, and complexed forms. Enhanced primary antibody responses to complexes of toxoid and specific gamma globulin were clearly shown. The degree of enhancement was closely related to the ratios of antigen and antibody in complex. More than three times as much total radiation was required to depress primary responses to the complexed toxoid compared with the toxoid only. (HLW)

33482 (BNL-50418, pp 167-180) PRIMARY AND SECONDARY IMMUNE RESPONSES RELATED TO RADIATION EXPOSURE: LOCALIZED IRRADIATION. Eltringham, J. R. (Univ. of Utah, Salt Lake City); Weissman, I. L. 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

Rats were sensitized by injection of sheep erythrocytes and Freund's adjuvant injected into an anterior paw. The upper extremity proximal to the paw was x-irradiated; the sensitized paw and the rest of the animal were shielded. Results showed that when sheep erythrocytes were injected into a single foot pad, repeated irradiation of the draining node region prevented both local and distant development of antibody-forming cells. If regional node irradiation is limited to a time when the nodes are the sole site of indirect antibody-forming cells, both subsequent local antibody-forming cell development and the spread of the indirect response to the spleen are inhibited as is the appearance of serum antibodies. By delaying regional node irradiation until the splenic indirect antibody-forming cell production has peaked, the depression of local node indirect antibody-forming cell production is more profound than in the spleen and does not affect serum antibody levels. (HLW)

33483 (BNL-50418, pp 225-244) ROLE OF THE REGIONAL LYMPH NODES IN TUMOR IMMUNITY. Perez, C. A.; Stewart, C. C.; Wagner, B. (Washington Univ., St. Louis). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

The role of lymph nodes in tumor immunity is reviewed with regard to the following factors: role of regional lymph nodes in initiation of the immune response; morphological and physiological changes following antigen exposure; barrier function of lymph nodes; presence of tumor cells in regional lymph nodes of mice bearing irradiated or nonirradiated tumors; effect of regional lymphadenectomy on the immune response; effect of local irradiation on regional lymph nodes; passive transfer of adoptive immunity by lymph node cells; and clinical implications. (HLW)

33484 (BNL-50418, pp 293-313) TUMOR IMMUNOTHERAPY WITH ANAEROBIC CORYNEBACTERIA: ASSESSMENT WITH LUNG COLONY ASSAY. Milas, K. (Univ. of Texas, Houston). 1974.

From interaction of radiation and host immune defense mecha-

nisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

C. granulosum given to mice within a week following tumor cell inoculation reduces the number of pulmonary metastases, the reduction being more marked as the time between inoculation of tumor cells and application of the immunostimulant is shortened. Some treated mice survived, which implied that complete regression of established pulmonary metastases had occurred. C. granulosum also induced complete regression of established tumors growing in s.c. tissue. Irradiation of mice before injection of tumor cells increases the incidence of pulmonary metastases. Treatment of animals with C. granulosum within 2 weeks prior to irradiation not only abolished this radiation effect but also reduced the number of lung nodules below that found in normal control mice. However, if mice were first irradiated and 1 or 2 days later treated with C. granulosum, the radiation effect on the formation of pulmonary metastases was not affected. Treatment of mice with C. granulosum reduces the number of pulmonary metastases of the poorly antigenic mammary carcinoma and also prolongs the survival of recipients. The effect was less than that observed for fibrosarcoma, which indicates that the "strength" of tumor-specific antigens is an important factor in nonspecific immunotherapy. Tumors that regress in C. granulosum-treated mice are diffusely infiltrated with lymphocytes, histiocytes, and macrophages. The mechanism(s) by which C. granulosum (or other anaerobic corynebacteria) induces protection against tumors is not known. It seems most likely that the lymphoreticuloendothelial system, which proliferated extensively in treated mice, responds more strongly to tumor-specific antigens. Also, macrophages from these mice can destroy tumor cells in an immunologically nonspecific manner. Since C. granulosum appears to exert the strongest antitumor adjuvant activity of all immunostimulants thus far known, it might be very useful for immunotherapy of malignant tumors in man. (auth)

33485 (BNL-50418, pp 363-378) SEROLOGIC IMMUNOTHERAPY AND INTERACTION WITH RADIATION. Order, S. E.; Donahue, V.; Knapp, R. (Harvard Medical School, Boston). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

Ovarian carcinomas of mice were used as a source of antigen; the ovarian tumor cells were injected intraperitoneally into experimental mice and antiserum was administered intraperitoneally 24 hr later. Some mice were given 150 to 400 rads of whole-body x radiation; others were shielded so that the abdomen only was irradiated. Results showed that when antiserum was administered intraperitoneally 24 hr after tumor transplant, 50 to 90% of mice survived in contrast to 90% mortality of controls. Graphs are presented to show results. (HLW)

33486 (LA-5883-PR) BIOMEDICAL AND ENVIRONMENTAL RESEARCH PROGRAM OF THE LASL HEALTH DIVISION. Annual Report, January–December 1974. Anderson, E. C.; Sullivan, E. M. (comps.). (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1975. Contract W-7405-ENG-36. 165p. Dep. NTIS $7.60.

The report summarizes research and development activities of LASL's Biomedical and Environmental Research Program for calendar year 1974. Summaries of research activities in the following groups are included: mammalian radiobiology; industrial hygiene; environmental studies; cellular and molecular radiobiology; biophysics and instrumentation; and organic and biochemical synthesis. Separate abstracts were prepared for each of the six sections of this report. (ERB)

For abstracts of individual sections see: 32629, 32995, 33143, 33335, 33381, and 33535.

33487 (NIRS-13) ANNUAL REPORT, 1973. (National Inst. of Radiological Sciences, Chiba (Japan)). Sep 1974. 82p. Dep. NTIS (US Sales Only) $7.25.

This thirteenth annual report contains abstracts of the main research projects conducted at NIRS during the 1973 fiscal year. The summaries are grouped into four main categories: physical sciences, including physics and chemistry; biological studies, including biochemistry and biophysics, cytology and morphology, physiology, and genetics; medical studies; and environmental studies. (ERB)

33488 (ORNL-5016, pp 50-61) AQUATIC ECOSYSTEM STUDIES. Blaylock, B. G.; Allen, C. P.; Cushman, R. M. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

Progress is reported on the following research projects: laboratory studies of chronically irradiated populations of the mosquitofish, Gambusia affinis; relative biological effectiveness of internal alpha-emitters; abnormalities in fish populations from White Oak Lake; sensitivity of calanoid copepods to acute ionizing radiation; differential distribution of ^{137}Cs in sediments; environmental effects of antifoulants; effects of chlorine-containing organics in aquatic ecosystems; model of copepod population dynamics; evaluation of the use of chlorine at power plants; and interactive effects of chromium compounds. (HLW)

33489 RESPONSE OF SPERMATOGONIA OF THE MOUSE TO HYCANTHONE: A COMPARISON WITH THE EFFECT OF GAMMA RAYS. Oakberg, E. F. (Oak Ridge National Lab., TN). pp 197-207 of Physiology and Genetics of Reproduction. Part A. Coutinho, E. M.; Fuchs, F. New York; Plenum Publishing Corp. (1974).

The stem cell of the seminiferous epithelium was identified as a type A spermatogonium with an oval, darkly staining nucleus in cross-sections and a spherical or ovoid shape in tubule whole mounts. The stem spermatogonia occur as single, isolated cells, in contrast to the groups of differentiating spermatogonia which form "chains" of cells connected by cytoplasmic bridges. Some stem cells have very long cell-cycle times (8+ days in the mouse); others have cycles only slightly longer than the 26 to 28 h characteristic of differentiating spermatogonia. The spermatogonial stem cells are further characterized by high resistance to radiation and noxious agents, in general. The cell-specific response characteristic of radiation also was observed after hycanthone injection for A_3, A_4, and intermediate (In) spermatogonia. The killing of A_3 and A_4 spermatogonia by hycanthone, however, was much less than would have been predicted for radiation doses giving comparable survival for A_3, A_4, and In spermatogonia. Dose, route of administration (i.p. or i.m.), time of observation, and cell stage all were important variables in the response to hycanthone. Whereas the use of a specific cell type, time of observations, end point, and dose may be useful in demonstrating the action of a chemical, extreme care must be used in estimating possible hazards to the organism from such information. Failure to observe mutagenicity of hycanthone in the mouse has raised the obvious question of whether the drug reaches the germ cells. The cytotoxic effect demonstrated by the data presented here indicates that either hycanthone or toxic metabolites of the drug do reach the spermatogonia in significant quantities. (auth)

33490 EFFECTS OF HIPPOCAMPAL GRANULE-CELL AGENESIS ON ACQUISITION OF ESCAPE FROM FEAR AND ONE-WAY ACTIVE-AVOIDANCE RESPONSES. Haggbloom, S. J.; Brunner, R. L.; Bayer, S. A. (Purdue Univ., Lafayette, IN). J. Comp. Physiol. Psychol.; 86: No. 3, 447-457(1974).

The head region of the hippocampus was irradiated with low-level x ray in infant rats. This reduced the total number of hippocampal granule-cells by an average of 84%. Four experiments extended the behavioral similarities previously noted between such hippocampal granule-cell agenesis and conventional hippocampal lesions. Irradiated and control rats were alike in the acquisition of a one-way avoidance response, although there was a trend of greater resistance to extinction in the irradiated group. The irradiated group displayed facilitated acquisition of an escape-from-fear response. When one-way avoidance was preceded by inescapable shock, the irradiated group was superior, suggesting that granule-cell loss, like hippocampal ablation, disrupts a tendency to remain immobile in the presence of stimuli related to inescapable punishment. (auth)

33491 HIPPOCAMPAL DEVELOPMENT IN THE RAT: CYTOGENESIS AND MORPHOGENESIS EXAMINED WITH AUTORADIOGRAPHY AND LOW-LEVEL X IRRADIATION. Bayer, S. A.; Altman, J. (Purdue Univ., Lafayette, IN). J. Comp. Neurol.; 158: No. 1, 55-80(1 Nov 1974).

The cytogenesis and morphogenesis of the rat hippocampus was examined with the techniques of ^3H-thymidine autoradiography, cell pyknosis produced by low-level x-irradiation, and quantitative histology. The procedure of progressively delayed cumulative labelling was used for autoradiography. Groups of rats were injected with four successive daily doses of ^3H-thymidine during non-overlapping periods ranging from birth to day 19. They were killed at 60 days of age, and the percentage of labelled cells was determined. The pyramidal cells of Ammon's horn and the polymorph cells of the dentate gyrus are not labelled postnatally, confirming earlier conclusions of their prenatal origin. In the dentate gyrus, 85% of the granule cells are formed postnatally, with 45% forming during the first week. The majority of the small cells of the dentate molecular layer and of the Ammonic strata oriens, radiatum, and lacunosum-moleculare are formed during the second week. As an aid to locating the proliferative compartments of the hippocampus during development and to characterize the time course of both cell differentiation and morphological development, rats ranging in age from gestation

day 17 to postnatal day 103 were killed six hours after one exposure to 200R x rays, and the pyknotic cells were counted. Possible mechanisms for the morphological development of the dentate gyrus along with a consideration of the possible migratory route of granule cell precursors are discussed. (auth)

33492 EFFECTS OF CHRONIC IRRADIATION ON COMPLEMENT CONSUMPTION IN NORMAL SERA. Chlebovska, K.; Cabadaj, S.; Chlebovsky, O.; Praslicka, M.; Bernasovsky, I. (Safarik Univ., Kosice, Czech.). Biologia (Bratislava); 28: No. 12, 961-968(1973). (In German).

Complement consumption by normal rat sera after chronic gamma irradiation is discussed. After daily doses of 40 R and 80 R, no substantial changes occurred in the reaction within 40 days; at most intervals a minor increase could be observed in the reaction rate. After daily doses of 120 R, a decreased rate of the reaction was observed 4 days after the irradiation. From the 4th day on, a marked decrease was found in the number of lymphocytes in peripheral blood in all irradiated groups. (Nucl. Sci. Abstr. Czech)

33493 QUANTITATIVE HISTOPATHOLOGY IN RELATION TO RADIOSENSITIVITY AND RESPONSE. Casarett, G. W.; Eddy, H. A.; Nelson, J. M. (Univ. of Rochester, NY). Front. Radiat. Therm. Oncol.; 9: 65-91(1974).

Although the data on quantitative histologic analyses of tumors and normal pouch tissues, nonirradiated and irradiated, are not yet complete and represent largely a progress report and presentation of a model of histopathologic approach to such studies, the data obtained to date are encouraging and support the feasibility of the approach. Certainly there has existed a large need for more information of the kinds that such an approach can provide. The correlation of the quantified histopathologic data with cellular radiobiologic data and circulatory data on tumors of various kinds and properties should contribute considerably to our understanding of the bases for initial relative radiosensitivity and relative radiocurability of tumors and for highly effective dose-time relationships in radiotherapy. (auth)

33494 SUPPLEMENTARY PATHOMORPHOLOGICAL INVESTIGATIONS OF THE GASTROINTESTINAL TRACT AFTER VARYING IRRADIATION OF SWINE. Johannsen, U.; Koch, F.; Mehlhorn, G.; Panndorf, H. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Tierproduktion und Veterinaermedizin); Neumeister, K. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Radiologische Klinik). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 20-26(1974). (In German).

Three months-old swine were exposed to lethal whole-body x irradiation and to lethal fractionated abdominal x irradiation. As the animals were not dying at the peak of intestinal damage a supplementary influence of multiplying E. coli and their endotoxin production is discussed. A comparison of irradiated small and large intestine crypts points out that the regeneration starts earlier and is more ordered in the small intestine crypts. (INIS)

33495 DETERMINATION OF THE TOXIC EFFECT OF AET ON RAT EMBRYONIC CELLS. Ucer, E.; Bolukbasi, E. (Univ., Istanbul). Istanbul Univ. Fen Fak. Mecm., Seri B; 37: No. 3-4, 145-148(1972).

The toxic effect of the radioprotector, AET, for rat embryonic cells in tissue culture was investigated. Various concentrations of AET, 16 to 45 mM, were employed in the experiments. As a result, the highest nontoxic and lethal doses of AET were found to be 20 and 45 mM respectively. (INIS)

33496 ACUTE GASTROINTESTINAL REACTIONS TO VARYING IRRADIATION IN SWINE. Koch, F.; Mehlhorn, G.; Panndorf, H.; Johannsen, U. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Tierproduktion und Veterinaermedizin); Neumeister, K.; Gursky, S.; Oelssner, W. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Radiologische Klinik). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 10-14(1974). (In German).

The gastrointestinal radiation injuries in swine following a single lethal whole-body irradiation or sublethal and lethal fractionated abdominal irradiation with x rays are compared with each other. The dependence of the reactions on the applicated radiation doses is demonstrated. (INIS)

33497 ON SOME PATHOPHYSIOLOGICAL INVESTIGATIONS OF THE GASTROINTESTINAL TRACT AFTER VARYING IRRADIATION OF SWINE. Neumeister, K. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Radiologische Klinik); Panndorf, H.; Koch, F.; Mehlhorn, G.; Johannsen, U. (Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Tierproduktion und Veterinaermedizin). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 15-19(1974). (In German).

After fractionated x irradiation of the porcine abdomen a dose-dependent retardation of stomach emptying and of small intestine motility was observed radiologically. Some liver functions as bilirubin metabolism and plasma content of transaminases did not change. (INIS)

33498 STUDIES ON THE EFFECT OF X-RAYS ON THE NEUROSECRETORY SYSTEM OF WHITE MICE. Czechowicz, K. (Akademia Medyczna, Wroclaw (Poland)). Zool. Pol.; 22: 135-149(1973).

Investigations were made to trace changes in the neurosecretory nuclei of the hypothalamus, following x-ray irradiation of white mice. From the results it can be inferred that the neurosecretory cells destroyed by irradiation are replaced by cells from the neurohypophysis, and that the changes caused in the npo, npv and nso, due to the x-ray dose used, are reversible. (auth)

33499 EFFECTS OF COMBINED EXPOSURE TO SHF ELECTROMAGNETIC FIELDS AND SOFT X-RAY RADIATION ON THE PERIPHERAL BLOOD. Sokolova, I. P. Tr. Lab. Elektromagn. Polei Radiochastot Inst.; No. 4, 95-99(1973). (In Russian).

Under conditions of a chronic experiment exposure to a combination of low intensity SHF field and soft x-ray radiation (25 roentgen/week) led to a decrease in the number of leukocytes (due to a decrease in the absolute number of lymphoid elements) and erythrocytes, and an increase in the reticulocytes. Analogous changes of these indices were observed when the animals were exposed to microwaves alone. (Referativnyi Zh.)

33500 SOME OBSERVATIONS ON THE EPIDEMIOLOGY AND THE PATHOLOGY OF RETICULUM CELL SARCOMAS IN (C57BL/Cne × C3H/Cne)F_1 MICE. Covelli, V.; Metalli, P.; Bassani, B.; di Caterino, B.; Silini, G. (CNEN, Rome). Tumori; 59: 97-118 (1973). (In Italian).

Life-long observations on untreated animals have shown that spontaneous reticulum cell sarcomas (RCS) developed in 56.5% male mice of the hybrid (C57BL/Cne × C3H/Cne)F_1 strain; the average age at death of mice with tumors was 949 days, compared with 929 days for all causes; no age-specific peak of mortality has been shown to occur over the entire life span of the animals. Histologically, the spleen and all the lymph nodes, including the mesenteric node, were always invaded; neoplastic growth was found less frequently in kidneys, liver, and lungs (77, 70, and 40%, respectively), only occasionally in other organs such as adrenals and testes, and never in the thymus. The tumor was predominantly composed of a single type of neoplastic cells, resembling highly undifferentiated reticular cells, typically proliferating from the periarteriolar region of the lymphatic follicles in the spleen. The monomorphic aspect of the tumor cell population suggests that RCS in this strain of mice may be classified as type A according to Dunn. Electron-microscopy observations showed the presence of a few virus-like particles both in tumor cells and in sediments from cell-free extracts. Transplantation of cells from spontaneous RCS into both normal and lethally-irradiated syngeneic recipients was successful only in 4 out of 7 experiments, regardless of the tissue of origin of the neoplastic cells (spleen, lymph nodes, or bone marrow). Virus-like particles were seen with higher frequency in transplanted tumors. Inoculation of cell-free extracts into neonatal mice of low-leukemia strains has not so far been successful. Splenectomy of young animals as well as the intravenous injection of syngeneic bone marrow cells immediately following a lethal dose of whole-body X-irradiation significantly reduced the frequency of spontaneous tumors. (auth)

33501 THYMIC REGENERATION AFTER LETHAL IRRADIATION: EVIDENCE FOR AN INTRA-THYMIC RADIORESISTANT T CELL PRECURSOR. Kadish, J. L.; Basch, R. S. (New York Univ., NY). J. Immunol.; 114: No. 1, 452-458(Jan 1975).

The data presented indicate the existence of a significant pool of radioresistant stem cells which are capable of partially restoring the thymus of heavily irradiated mice. ^{3}H-TdR incorporation by the thymus of lethally irradiated mice begins 48 to 72 hr after irradiation and increases throughout the next 8 days. By the 9th day after 760 rads, typical corticomedullary architecture has been restored. 890 rads markedly suppressed, but did not totally eliminate this regeneration. Injection of large numbers of syngeneic bone marrow cells immediately after irradiation was without effect on the rate or extent of regeneration. Mice whose bone marrow and spleen were shielded from irradiation showed an identical amount of thymic regeneration as those receiving total body irradiation indicating that the precursor cell pool responsible for the early post irradiation phase of thymic regeneration is most likely an intrathymic population. The cells repopulating the thymus were morphologically indistinguishable from normal thymocytes and were susceptible to cytotoxic antisera against the thymic differentiation antigens Thy-1, TL, LyA_2 and LyC_2. (auth)

33502 EXPOSURE-RATE RESPONSE IN THE PRENATALLY IRRADIATED RAT: EFFECTS OF 50 R ON THE 18TH DAY OF GESTATION TO THE DEVELOPING TESTIS. Strange, J. R. (UT-AEC Agricultural Research Lab., Oak Ridge, TN). Bull. Ga. Acad. Sci.; 33: No. 1, 41-48(Jan 1975).

Pregnant rats were irradiated on the 18th day of gestation with a total exposure of 50 R at rates of 1, 3, 10, 25, and 47 R/min. Testes of the progeny were evaluated at 28, 49, 70, 91, and 210 days post partum. At 28, 49, 70, and 91 days an exposure-rate response was present as determined by evaluating the most advanced cell type in seminiferous tubule cross sections. A rapid increase in damage was associated with increasing exposure rate up to 10 R/min. The effects of 25 and 47R/min appeared to be less damaging than those of the 10 R/min rate. (auth)

33503 POPULATION STUDY OF IRRADIATED DESERT RODENTS. French, N. R.; Maza, B. G.; Hill, H. O.; Aschwanden, A. P.; Kaas, H. W. (University of California, Los Angeles). Ecol. Monogr.; 44: No. 1, 45-72(Win 1974).

An experiment was begun in 1963 to evaluate effects of long-term low-level radiation exposure on desert populations of plants and animals. Monthly censuses of four species of heteromyid rodents in three 9-ha enclosures and one non-enclosed area indicate great year-to-year changes in densities of the non-irradiated populations and even greater fluctuations in the irradiated populations. Although magnitude of density changes varied, timing of fluctuations was similar. In a good growing season a population may increase by a factor of 5 or more. In a poor growing season there may be no reproduction. Chronic radiation exposure to Perognathus formosus was measured to be 211-360 r/year. This reduced survival, particularly before the age of 6 mo. The instantaneous rate of death for the irradiated population during this period was 0.219, and for the control populations was .075 and 0.104. Future life expectancy at age 1 mo in the irradiated population was 9.2 mo, and for the control populations was 11.4 and 14.4 mo. The computed intrinsic rate of increase for the irradiated population was 0.314, compared to 0.493 and 0.498 for the two control populations. Demographic and histologic evidence indicate an increased birth rate in the irradiated population. A population consisting of animals 3 yr old and older, having been subjected to a lifetime of such radiation exposure, would likely be incapable of reproduction. Therefore, only in the most unfavorable periods, when reproduction is curtailed by natural factors, will the threshold levels of artificial radiation insult on the natural population be discernible. A rapid turnover of generations prevents a population from accumulating damaging effects of low-level exposure. The diets of rodents were analyzed, and the production of important foods was measured over 3 yr. Seeds and vegetative parts of plants made up approximately equal portions of the diet. All parts of the small annual plant Thelypodium were highly selected at all seasons. Total production of food shows a lag effect in relation to precipitation. Estimates of food requirements of the rodent population, based on laboratory feeding trials, suggest that food supply may be an important limiting factor. Populations respond strikingly to periods of favorable vegetative growth. Desert rodent populations are adapted to withstanding periods of unfavorable conditions. They have comparatively long life-spans and maintain fertility. These adaptations make them vulnerable to changed conditions, such as environmental contamination. (auth)

33504 EFFECT OF ASCORBIC ACID ON THE SURVIVAL OF RATS AFTER WHOLE BODY IRRADIATION. Ala-Ketola, L.; Varis, R.; Kiviniitty, K. (Oulu Univ. (Finland). Dept. of Roentgenology; Oulu Univ. (Finland). Dept. of Physiology; Oulu Univ. (Finland). Dept. of Radiotherapy). Strahlentherapie; 148: No. 6, 643-644(Dec 1974).

Fifty rats were irradiated with a 900 rd whole-body dose of gamma radiation. When the rats were given large amounts of ascorbic acid (6 to 8 Mg/100 g/day), mortality decreased significantly and the average increase of weight after the 12th day following irradiation was significantly greater than in the control group. (auth)

33505 STUDIES ON CHEMICAL PROTECTORS AGAINST RADIATION. XIV. Radiation Protective Activities of Sulfur-Containing Compounds Against X Irradiation. Shinoda, M.; Ohta, S. (Hoshi Coll. of Pharmacy, Tokyo (Japan)); Takagi, Y.; Akaboshi, S. Yakugaku Zasshi; 94: No. 11, 1419-1424(Nov 1974). (In Japanese).

Examinations were made on the relationship between the chemical structure of 47 kinds of sulfur-containing compounds, both SH-type and non-SH-type, and toxicity to male ddY mice, and the protective effect of their lethal dose against x irradiation. Among the compounds tested, 22 compounds were found to prolong the survival of x-irradiated mice, but there was no definite evidence for a relation between chemical structure and survival effect, or between toxicity and survival effect. Thiourea, methylthiourea, ethylenethiourea, methylisothiourea, and ethylisothiourea were found to be radioprotectors with a low toxicity. (auth)

33506 CEREBRAL ARTERY REPLACEMENT BY USE OF ARTERIAL GRAFT IRRADIATED WITH HIGH VOLTAGE CATHODE RAY. A Study of Static Dynamics. Kudo, S. (Kansai Medical School, Moriguchi, Osaka (Japan)). Hyogo Ika Daigaku-Shi.; 3: No. 1, 81-93(Sep 1974). (In Japanese).

Irradiated and non-irradiated canine arterial segments were implanted subcutaneously in the rat flank. Macroscopic and histologic examinations of the irradiated heterologous implants revealed an inhibited tissue reaction which was markedly influenced by the doses of irradiation: 2 M rads or more was necessary. Removed canine carotid was completely sealed at both ends by glass, and then inflated by gradual injection of saline into the carotid lumen under an increased pressure. The intraluminal pressure and the increase in length of carotid were measured and plotted to depict a tension-length curve. The carotid, whether irradiated or not, was usually elongated in proportion to the increment of the initial intraluminal pressure and then became rather constant in length in spite of higher intraluminal pressure. Consequently, the tension-length curve was parabola-like, and the initial elongation of carotid might be due to the elasticity of elastin and the final limitation of elongation due to a jacket-like function of collagen. The carotid irradiated at a dose of 0.5 M rads became much longer than the non-irradiated one, when the intraluminal pressure was tolerably increased and demonstrated the maximum length. At a dose of 2 M rads, the irradiated carotid showed similar tension-length curve as did the control carotid. At a dose of 20 M rads, the irradiated carotid exhibited the minimum length, much shorter than the control carotid, irrespective of the increased intraluminal pressure. The carotid graft irradiated at the dose of 2 M rads would be an adequate candidate for homologous or heterologous transplantation in the field of reconstructive vascular surgery. (auth)

33507 THE EFFECT OF IONIZING RADIATION (^{60}Co) ON SOME HUMORAL AND CELLULAR FACTORS OF NATURAL IMMUNITY IN GERM-FREE PIGLETS. Miler, I.; Mandel, L.; Moravek, F. (Ceskoslovenska Akademie Ved, Prague. Oddeleni Immunologie; Ceskoslovenska Akademie Ved, Prague. Laborator Gnotobiologie; Karlova Universita, Hradec Kralove (Czechoslovakia). Oddeleni Radiobiologie). Strahlentherapie; 148: No. 6, 624-632(Dec 1974).

Using the germ-free, newborn, colostrum-deprived piglets, irradiated with gamma rays (^{60}Co), the following factors of anti-infectious natural resistance were studied: The level of hemolytic complement, bactericidal activity of sera to E. coli, in vivo phagocytosis of bacteria, antiendotoxic resistance, and the antibacterial barrier function of the intestinal mucous membrane. It was found that, whereas the supralethal irradiation (1,200 R) produced a significant depression of the serum complement level, no changes in the bactericidal, opsonic, and phagocytic activity occurred. In addition, no significant increase in the susceptibility to the lethal effect of endotoxin was found. An increased penetration of E. coli into the mesenteric nodes took place after irradiation of E. coli-monoassociated piglets with lethal exposures of gamma rays. (auth)

33508 INVESTIGATIONS ON COMBINED INJURIES. XXI. The Kininogen Level in Mice After Combined Skin Lesion and X-ray Irradiation. Reichenbach-Klinke, K. E.; Werle, E.; Henneberg, R.; Messerschmidt, O. (Muenchen Univ. (F. R. Germany). Inst. fuer Klinische Chemie und Klinische Biochemie; Laboratorium fuer Experimentelle Radiologie, Neuherberg/Muenchen (F.R. Germany)). Strahlentherapie; 148: No. 6, 619-623(Dec 1974). (In German).

In female mice, the kininogen-level in plasma was determined after whole-body irradiation (700 R), after excision of 1 cm^2 of skin, and after combination of the two injuries. After the skin excision, the concentration of kininogen was slightly elevated. After the irradiation the level of kininogen in plasma was not changed. After combination of the two injuries the concentration of kininogen was elevated to about 100% of the former level within 4 days. The possible reasons for these effects are discussed. (auth)

33509 RADIATION EFFECTS ON TESTES. IV. Studies on Succinic Dehydrogenase, Cytochrome Oxidase, Adenosine Triphosphate, and Physical Behavior of Mitochondria Following Localized Gamma Irradiation. Gupta, G. S.; Bawa, S. R. (Punjab Univ., Chandigarh (India). Dept. of Biophysics). Strahlentherapie; 148: No. 6, 633-642(Dec 1974).

During the early period of a radiation injury, the effects of radiation on bioenergetics and enzymes of Krebs cycle are not conspicuous. The responses of radiation on ATP and Krebs cycle enzymes are secondary effects of a radiation damage.

Following the first week, ATP levels decline as the radiation injury progresses and does not show normalization at both lethal and sublethal doses up to 11 months. Declining levels of ATP in testes homogenates are associated with decreased viscosity and reduced optical absorption at 520 mμ by isolated mitochondrial suspensions, thus showing general disintegration or shrinkage of mitochondrial particles of testicular cells. Succinic dehydrogenase and cytochrome oxidase, however, declined after an initial rise during the first week. After the second week of radiation, specific activity of succinic dehydrogenase in radiated testes shows that atrophied testes retain the oxidative metabolism through Krebs cycle. (auth)

33510 CHEMOTHERAPY OF RADIATION DISEASE IN EXPERIMENTAL ANIMALS WITH THE INTESTINE MICROFLORA RESISTANT TO ANTIBIOTICS. Tunanyan, M. A.; Izvekova, A. V. (Akademiya Meditsinskikh Nauk SSSR, Moscow. Inst. Ehpidemiologii i Mikrobiologii). Antibiotiki; 19: No. 3, 232-235 (Mar 1974). (In Russian).

A study was made of the efficiency of a number of widely used antibiotics in treating the infectious complications of radiation sickness in animals (rats, rabbits) with intestinal microflora resistant to a number of antibiotics. It is shown that the efficiency of various antibiotics and combinations of these antibiotics in the treatment of irradiated animals with intestinal microflora resistant to previously used antibiotics does not differ from the efficiency of treating the irradiated animals with normal microflora. The most effective agents for treating infectious complications of radiation sickness with intestinal microflora resistant to penicillin, streptomycin, and levomycetin turned out to be erythromycin and combinations of canamycin with tetracyclin, canamycin with erythromycin, and ampicyllin with erythromycin. (tr-INIS)

33511 THE EFFECT OF CERTAIN ERYTHROPOIESIS STIMULATORS ON REGENERATION OF ERYTHROCYTE SYSTEM IN RATS AFTER WHOLE BODY IRRADIATION WITH SUBLETHAL DOSE OF X-RAYS. Paprocka-Slonda, E.; Kuratowska, Z. (Institute of Nuclear Research, Warsaw (Poland)). Acta Haematol. Pol.; 4: 247-253(1973). (In Polish).

Wistar rats were used for study of the effects of known stimulators of erythropoiesis on radioinduced changes following one dose of 500 R of x rays to the whole body. Exogenous erythropoietin administered in single and repeated doses had no effect on the characteristics of radio-induced disturbances of erythropoiesis without respect to the time of its administration in relation to the moment of exposure. Cobalt chloride given before or after the exposure similarly had no effect on radio-induced inhibition of erythropoiesis in rats. Testosterone increased plasma erythropoietin activity if it was given before or on the 5th, 6th, and 7th days after exposure. However, stimulation of erythropoiesis (determined by incorporation of radioactive iron into red blood cells) was observed only if testosterone was injected on the 5th, 6th, and 7th day after exposure. This seems to suggest that this hormone has a direct action on haemopoietic cells. (auth)

33512 THE EFFECT OF SUBLETHAL (500 R) DOSE OF X-RAYS ON ERYTHROPOIESIS IN RATS. Paprocka-Slonka, E.; Kuratowska, Z. (Institute of Nuclear Research, Warsaw (Poland)). Acta Haematol. Pol.; 4: 239-245(1973). (In Polish).

In Wistar rats exposed to a single dose of 500 R of x rays to the whole body the erythropoietic activity of bone marrow and plasma erythropoietin activity were determined at various time intervals after exposure. Using the method of radioactive iron incorporation into red blood cells, inhibition of production of young erythrocytes was found on the first days after exposure. It was most pronounced on the 4th day after exposure. On the 5th day the so-called phase of abortive regeneration appeared. Return of normal values was observed after 14 days, and after 21 days hyperregeneration of the erythrocyte system occurred. The biological test for erythropoietic activity of rat plasma after exposure to radiation showed a decreased activity in the first period after exposure with a normal regenerating trend. In myelograms radiation-induced injury of bone marrow was observed with a gradual increase in its intensity reaching a peak on the 4th day after exposure and followed by a gradual regeneration of haemopoietic tissues. Return of normal values was observed only after 21 days. (auth)

33513 EFFECT OF PARABIOSIS ON LIFE-SPAN OF RATS STRESSED BY RADIATION. Warren, S.; Chute, R. N.; Porter, M. W. (New England Deaconess Hospital, Boston). J. Gerontol.; 30: No. 1, 15-21(1975).

The life-spans of four series of NEDH rats were compared: (1) single control rats, (2) single rats irradiated with 1000 R, (3) control parabiont rats, (4) parabiont rats one of which had received 1000 R. The stress of radiation (1000 R) produced a median life shortening of 571 days in single rats. Parabiosis followed by irradiation (1000 R) of a member of the pair shortened life 132 days. Parabiosis alone produced a median life shortening of 62 days. Ninety percent of the older irradiated parabiont pairs died with one or more tumors present. Parabiosis largely protected animals from the gastrointestinal radiation syndrome. (auth)

33514 HEREDITARY METABOLIC ANOMALY (HYPERBILIRUBINAEMIA) AS RADIOSENSITIZER. Fritz-Niggli, H.; Michel, C.; Neck, K.; Stahel, A.; Vollenweider-Wepfer, R. (Zurich Univ. (Switzerland). Strahlenbiologisches Inst.). Radiat. Environ. Biophys.; 11: No. 3, 195-202(Oct 1974).

The possibility of modifying various radiation damages by a patho-physiological factor was examined in experiments with Gunn rats homozygous for the recessive factor j, suffering from jaundice [hyperbilirubinaemia] due to a defect in the glucuronidase system. In the majority of the examined radiation damages, an intensification of the radiation effects in j/j animals became manifest. The strongest sensitization to radiation effects was observed in cases of induction of malformations in 9 day old rat embryos. Likewise, mitotic inhibition in the small intestine epithelium of j/j Gunn rats was considerably more pronounced than in normal rats, and so was the inhibition of post-mitotic migration of cells in the small intestine crypts. An increased quantity of pathological anaphases and telophases in the regenerating j/j liver after a local irradiation could also be seen as well as an increased induction of chromosomal aberrations in the bone marrow of j/j animals. According to the authors' opinion the radiosensitizing attribute of the j gene is based principally on an inhibition of repair processes by bilirubin, in as much as bilirubin inhibits the intercellular energy metabolism. But other pleiotropic effects of the j gene cannot be excluded. The existence of a patho-physiological modifying factor of the radiation effect in mammals should be of interest to the clinician. (auth)

33515 EFFECTS OF X IRRADIATION ON LEAKAGE OF PHOSPHATE IONS FROM GHOSTS OF RABBIT RED BLOOD CELLS. Utsumi, H.; Kato, M. (Kyoto Univ. (Japan). Faculty of Science). J. Radiat. Res.; 14: No. 4, 403-410(Dec 1973).

Ghosts of rabbit red blood cells were prepared by hemolysis of red blood cells with distilled water, followed by restoration to an iso-osmotic plasma at the time of incubation. X irradiation stimulated the leakage of ^{32}P from ^{32}P-loaded ghosts. The effect was observed even at a dose of 500 R. X irradiation induced immediately an increase in cellular acid-soluble ^{32}P, which was partly responsible for the increase of leakage. The concomitant decrease in the level of acid-insoluble ^{32}P in irradiated ghosts recovered slightly within the first several minutes of incubation at 37°C. (auth)

33516 STUDIES ON HUMORAL AND CELLULAR IMMUNE RESPONSES IN FILARIASIS: USE OF NUCLEAR TECHNIQUES. Subrahmanyam, D.; Chaudhuri, S. (Postgraduate Inst. of Medical Education and Research, Chandigarh, India). pp 73-84 of Nuclear Techniques in Helminthology Research. Vienna; International Atomic Energy Agency (1975).

From proceedings on the use of nuclear techniques in research and control of helminthic infections; Nairobi, Kenya (26 Nov 1973). See STI/PUB-390; CONF-731167-.

Immune globulin of rats with latent infections of Litomosoides carinii was labeled with ^{14}C. Infected rats were treated with cyclophosphamide, x, or gamma radiation. Mites containing larvae were gamma-irradiated and fed to rats. Immune serum was injected into rats daily for seven days. Results are discussed with regard to serodiagnosis, host-parasite relation in the infection, role of humoral antibodies in acquired resistance, and factors involved in induction of resistance to infection. (HLW)

33517 A COMPARATIVE STUDY ON THE RESTORATION OF RADIATION-INDUCED DAMAGE IN MICE AND IN CULTURED MOUSE L CELLS. Hikita, M.; Horikawa, M. (Kanazawa Univ. (Japan). Faculty of Pharmaceutical Sciences); Tanaka, T.; Sugahara, T. J. Radiat. Res.; 14: No. 4, 417-422(Dec 1973).

The restorative effects of post-irradiation treatment with some nucleic acid precursors were studied in mouse L cells in culture and in mice irradiated with x rays. Deoxyribonucleosides increased the survival of L cells as well as mice while adenosine increased the survival of mice but not of L cells. The results suggest two different types of restoration in mammals. (auth)

Invertebrates

33518 (STI/PUB-390) NUCLEAR TECHNIQUES IN HELMINTHOLOGY RESEARCH. Panel Proceedings Series. Proceedings of a Panel on the Use of Nuclear Techniques in Research and Control of Helminthic Infections, Nairobi, Kenya,

November 26–30, 1973. (International Atomic Energy Agency, Vienna (Austria)). Jan 1975. 192p. (CONF-731167-). IAEA $11.00.

Separate abstracts were prepared for the 16 papers presented at the conference. (HLW)

For abstracts of individual papers see: 33516, 33526–33529, 33648–33654, and 35704–35707.

33519 PRELIMINARY STUDY ON THE REPRODUCTION OF ONCOMELANIID SNAILS FOLLOWING ^{60}Co γ IRRADIATION. Tung Wu Hsueh Pao; 20: No. 3, 290(Sep 1974).

The effects of ^{60}Co γ irradiation on the reproductive glands are investigated. A dosage of 7,000 roentgens caused the testicles and ovaries to shrink to half of the normal size. A dosage of 150,000 roentgens caused the snails to lose mating capability. A dosage of 7,000 roentgens can sterilize the snails completely. A dosage of 150,000 roentgens caused 99% of the snails to die. (JPRS)

33520 VARIABLE EFFECTS OF X IRRADIATION ON TRIBOLIUM CASTANEUM AND T. CONFUSUM DUE TO STRAIN AND AGE AT PUPATION. Soliman, H. Edmonton, Alberta; University of Alberta (1972). 91p.

Thesis.

Eight geographic populations of Tribolium castaneum and six of T. confusum were studied after single exposure (10kR) of the second day old pupae to x rays at 33°C and 70% relative humidity. In general, T. confusum was more radiosensitive than T. castaneum; however, within populations, increasing pupation time is associated with decreasing radiosensitivity. Populations of T. castaneum originating from warmer geographic localities were more resistant to radiation than those from colder localities. A general decrease in the mean adult survival after irradiation with increasing age at pupation was observed for all populations of T. castaneum (pooled). Developmental wing abnormalities and undifferentiated wing and abdomen were found to differ among populations and species. Populations originally from warm localities were more resistant to x-ray induction of developmental abnormalities. T. castaneum was more resistant than T. confusum in this respect. Artificial selection for fast, slow, and intermediate time to pupation in T. castaneum (Jamaica) was successful in producing lines which differed from the unselected line in this characteristic. (CA)

33521 DEOXYRIBONUCLEIC ACID SYNTHESIS IN ISOLATED POLYTENE NUCLEI OF DROSOPHILA HYDEI. Boyd, J. B.; Presley, J. M. (Univ. of California, Davis). Biochem. Genet.; 9: 309-325(1973).

DNA synthesis has been studied in polytene nuclei isolated from larval salivary glands of Drosophila hydei. The incubation conditions employed promote maximum incorporation of TTP-H^3 and retention of normal polytene chromosome morphology. The chromosome structure is sensitive to the Mg^{2+} concentration; a normal banding pattern is observed between 4 and 10 mm Mg^{2+}. At the optimum pH of 7.8, incorporation continues for over an hour. All four deoxyribonucleoside triphosphates are required for maximum incorporation. The reaction is stimulated by 0.6 mm ATP and strongly inhibited at higher ATP concentrations. Competition experiments demonstrate that either TDP or TTP is the effective labeled precursor. The labeled product is sensitive to DNase and has a density identical to that of nuclear DNA. Autoradiographs prepared from spread chromosomes demonstrate that discontinuous and continuous labeling patterns observed in vivo are also produced with isolated nuclei in the absence of cytoplasmic factors. Incubation of the isolated nuclei results in a low level of uniform incorporation that is superimposed on the normal autoradiographic pattern obtained after in vivo labeling. This background incorporation can be greatly increased by prior irradiation of the glands. The presence of exogenous DNA during nuclear incubation stimulates total incorporation. These observations demonstrate that the isolated nuclei possess a reserve synthetic capacity. About 20% of the isolated nuclei are inactive in DNA synthesis. (auth)

33522 DIROFILARIA IMMITIS: FATE AND IMMUNOGENICITY OF IRRADIATED INFECTIVE STAGE LARVAE IN BEAGLES. Wong, M. M.; Guest, M. F.; Lavoipierre, M. M. J. (Univ. of California, Davis). Exp. Parasitol.; 35: 465-474(1974).

Experiments were conducted on the fate of irradiated infective larvae of Dirofilaria immitis in dogs, and on the effect of these infections on a challenge dose of nonirradiated larvae administered at a later date. Six dogs were inoculated with 200 to 296 irradiated larvae; in no case was a patent infection established. No living worm was recovered beyond 66 days. Eight dogs inoculated with 200 to 2401 irradiated larvae over varying periods of time were exposed 57 to 190 days after the final inoculation of irradiated larvae, to a challenge infection of 200 to 250 nonirradiated (normal) larvae. The results showed that the number of worms which developed to maturity in these dogs was sharply reduced compared to that in the 5 controls (dogs inoculated with normal larvae only). The most striking effect was seen in vaccinated dogs which were challenged 3 months or more after the final administration of irradiated larvae. (auth)

33523 REPRODUCTIVE BIOLOGY AND RADIATION STERILIZATION OF THE SUGARCANE TOP BORER, TRYPORYZA NIVELLA. Ashraf, Mohammad; Anwar, Mohammad; Chatha, Najeebullah; Chatha, Nasrullah. (Atomic Energy Agricultural Research Centre, Tandojam (Pakistan)). Entomol. Exp. Appl.; 17: No. 1, 61-66(1974).

Reproductive biology and gamma sterilization of the sugarcane top borer, Tryporyza nivella F., were investigated under laboratory conditions. Mating took place on the night of emergence of the moths. Females were found to mate only once. One male mated for a maximum of four times when confined with five females. The mating frequency was maximum between 23.00 and 00.30 hr; the mating duration ranged from 60 to 165 min with an average of 127.5 min. On average, 113 eggs were laid by a mated female and 40 by a virgin female during the total life-span. The males and females had an average life-span of 2.6 days and 2.4 days, respectively. Radiation had no adverse effect on emergence, mating, and longevity of the adults. The males were completely sterilized at 15 kR and the females at 10 kR. (INIS)

33524 ACUTE EFFECTS OF X IRRADIATION ON MEMBRANE POTENTIAL AND MEMBRANE RESISTANCE OF SNAIL NEURONES. Guenther, J.; Hug, O. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Biologie). Radiat. Environ. Biophys.; 11: No. 3, 171-187(Oct 1974). (In German).

Acute x irradiation of the metacerebral giant neurones of Helix pomatia above 1,000 R or 3.4 kR/min (dose or dose rate threshold) leads to a significant reduction of the membrane potential. After blocking the afferent excitatory synapses, the radiation depolarizations are strongly decreased but not completely suppressed. Long-time irradiation at high dose rates and after the blocking of afferent synapses produces a depolarization in two phases: an immediate quick depolarization of about 10 mV is followed by a much slower decrease of the membrane potential. Substitution of extracellular sodium by tris ions suppresses the quick depolarization phase. The input resistance of the cell shows a transient increase at the beginning of irradiation followed by a substantial decrease. These results are discussed in view of the possible mechanisms of radiation-induced permeability changes in excitable membranes. (auth)

33525 APPLICATION OF THE STERILITY TECHNIQUE FOR THE ERADICATION OF THE PADDY BORER, TRYPORYZA INCERTULAS. K'un Ch'ung Hsueh Pao; 17: No. 2, 135-147 (May 1974).

The paddy borer, Tryporyza incertulas, is one of the most destructive insect pests of rice in southern China. From 1972, preliminary experiments have been carried out on the application of the sterility technique for control of the paddy borer. Two lines of research have been carried out: irradiation with gamma ray (^{60}Co); and treatment with the chemosterilant thio-tepa. The results obtained are summarized. (ERB)

33526 PREPARATION OF RADIATION-ATTENUATED VACCINES AGAINST HELMINTHIC INFECTIONS. Mulligan, W. (Univ. of Glasgow). pp 1-11 of Nuclear Techniques in Helminthology Research. Vienna; International Atomic Energy Agency (1975).

From proceedings on the use of nuclear techniques in research and control of helminthic infections; Nairobi, Kenya (26 Nov 1973). See STI/PUB-390; CONF-731167-.

The present position regarding radiation-attenuated vaccines against helminthic diseases of animals is reviewed and the criteria which influence the practical application of such vaccines are outlined. Various factors other than total radiation dose that may effect radiation-attenuation are also discussed. These include dose rate, larval concentration and temperature/oxygen effects. The importance of recognizing these factors in vaccine production is emphasized. (auth)

33527 POSSIBILITIES FOR APPLICATION OF THE CANINE HOOKWORM VACCINE TECHNOLOGY TO THE PREVENTION AND CONTROL OF HOOKWORM INFECTION AND DISEASE IN MAN. Miller, T. A. (Jensen–Salsbery Labs., Kansas City, KS). pp 61-68 of Nuclear Techniques in Helminthology Research. Vienna; International Atomic Energy Agency (1975).

From proceedings on the use of nuclear techniques in research and control of helminthic infections; Nairobi, Kenya (26 Nov 1973). See STI/PUB-390; CONF-731167-.

The licensing and commercial introduction of the sterile, irradiated, canine hookworm vaccine in the United States of

America represents a major advance in technology for the prophylaxis against helminth diseases. The industrial technology of this vaccine has been shown experimentally to be directly applicable to certain essential steps in the development of a potential vaccine for the control of hookworm infection of man. Although the occurrence and significance of immunity in the man-hookworm system is still largely conjectural and is based on circumstantial evidence, the balance of evidence indicates that an effective acquired resistance probably operates in this system. This is the most important residual deficiency in our knowledge of this host-parasite relationship. The aesthetic and economic considerations involved in the development and use of a human hookworm vaccine must also represent major relevant considerations. (auth)

33528 ATTEMPTS AT IMMUNIZATION AGAINST MALAYAN FILARIASIS USING X-IRRADIATED INFECTIVE LARVAE. Ramachandran, C. P. (Univ. Sains Malaysia, Penang). pp 101-114 of Nuclear Techniques in Helminthology Research. Vienna; International Atomic Energy Agency (1975).

From proceedings on the use of nuclear techniques in research and control of helminthic infections; Nairobi, Kenya (26 Nov 1973). See STI/PUB-390; CONF-731167-.

Recent studies on immunity to helminthic infections have shown that some degree of protective immunity may be stimulated by inoculations of attenuated living worms or their metabolites. Although much on these lines has been done with several helminths, little if any has been done with filarial infections in general. Experiments were designed to observe the effects of attempted immunization in the rhesus monkey as well as the domestic cat by the use of attenuated infective larvae of Brugia malayi. The sub-periodic strain of Brugia malayi, the major filarial parasite of man in Malaysia, maintained in the laboratory on experimentally infected cats and rhesus monkeys was used for the preparation of x-irradiated vaccines as well as for challenge inoculations. Third-stage infective larvae of Brugia malayi were obtained from experimentally fed Aedes togoi mosquitoes. Infective larvae were irradiated by x-rays, using a Dermopan x-ray unit at exposures between 10 to 40 kR. Rhesus monkeys and cats were inoculated twice with 100 to 400 attenuated larvae per inoculation at 2 week intervals and challenged about a month later by inoculation of 100 normal larvae. Control animals for each vaccination dose as well as for challenge doses were maintained. In rhesus monkeys persistent immunity to challenge infections (expressed as failure to cause microfilaraemia) was obtained in animals vaccinated with 200 infective larvae attenuated by x-irradiation at 20,000 R. Encouraged with the results obtained on rhesus monkeys, similar experiments on an enlarged scale using varying strengths of the vaccines were carried out on the domestic cat, which is a more receptive animal host for Brugia malayi. However, all cats vaccinated when challenged came down with patent infection indicating lack of any definite immunity. In all these experiments, results of vaccine control animals showed that inoculation of irradiated larvae was not followed by the infection of microfilaria in the blood, indicating that it is the challenge larvae (normal) that had developed and produced a patent infection. Post-mortem studies carried out on vaccine control rhesus monkeys and cats showed the presence of adult female worms (mostly sterile) in their tissues. It is suggested that x-irradiation does not at all times inhibit the development of infective larvae of Brugia malayi but may affect the reproductive capacity of the parasites to produce microfilaria. (auth)

33529 TOWARDS THE DEVELOPMENT OF A LIVE VACCINE FOR SCHISTOSOMIASIS. Taylor, M. G. (London School of Hygiene and Tropical Medicine). pp 165-173 of Nuclear Techniques in Helminthology Research. Vienna; International Atomic Energy Agency (1975).

From proceedings on the use of nuclear techniques in research and control of helminthic infections; Nairobi, Kenya (26 Nov 1973). See STI/PUB-390; CONF-731167-.

In recent experiments baboons were partially protected against S. mansoni challenge with heterologous cercariae of S. rodhaini or S. bovis (which died before maturing) as effectively as by previous infection with S. mansoni. Previous workers have likewise shown that good protection can be developed in rhesus monkeys immunized with bovine schistosome cercariae or with homologous cercariae radioactively attenuated so that they die during migration, or even in the skin. These results show that partial immunity to challenge is not dependent on the presence of adult worms of a previous infection, and foster hopes of developing a live vaccine using radioactively attenuated early stages of the parasite or heterologous infections that fail to mature. Work on this is proceeding in our laboratory in baboons and also in domestic animals, with encouraging results. We have found that, in sheep, four exposures to gamma-irradiated S. mattheei cercariae at four-weekly intervals reduced the expected S. mattheei challenge by 75%. Studies on the behavior of these irradiated immunizing cercariae in mice show that while penetration and migration through the skin and lungs is normal, the irradiated larvae remain stunted and all die within 36 days in the liver. (auth)

33530 EFFECTS OF THERMAL NEUTRONS ON LIVING CELLS. 1. Lethal Effects of Thermal Neutrons on Amoebae. Akaboshi, M.; Kawai, K.; Maeda, T. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). J. Radiat. Res.; 14: No. 4, 411-416(Dec 1973).

Lethal effects of thermal neutrons were compared with those of ^{60}Co γ rays on the two types of Amoeba proteus. D_{37} doses against γ rays were 2.5×10^5 (M-type) and 7.2×10^5 rads (P-type), and those for thermal neutrons were 9.1 and 11.7×10^{13} $n.cm^{-2}$ (total flux) respectively. Additions of AET, D_2O, or boron failed to increase or decrease the lethal effects of thermal neutrons. The lethal actions by thermal neutrons must arise by the nuclear reaction, namely, ^{31}P (n, γ) ^{32}P on DNA strands. When amoebae were irradiated by thermal neutrons on pre-γ-irradiated status, the lethal actions were markedly enhanced (γ-n effect). (auth)

33531 ENHANCEMENT OF UNFOLDING IN X-IRRADIATED SILKGLAND RIBOSOMES. Matsumoto, K.; Kobayashi, T.; Yoshii, G. (Hokkaido Univ., Sapporo (Japan)). J. Radiat. Res.; 14: No. 4, 399-402(Dec 1973).

Upon gradual removal of Mg^{++}, 81S ribosomes of silkglands were dissociated into 61S and 44S subunits. Irradiation of partially-dissociated ribosomes in a low Mg^{++} buffer (0.05 mM – 0.02 mM) resulted in enhancing the unfolding of 61S and 44S ribosomal subunits further into 39S and 25S. This result indicates that ribosomes become more radiosensitive in the unstable structure than in the stable one. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 32667, 33444, 33445, and 33630.

33532 DOSIMETRY IN PATIENTS WITH GRAVE'S DISEASE DURING TREATMENT WITH LITHIUM IN THERAPEUTIC ASSOCIATION WITH IODINE-131. Briere, J.; Pousset, G.; Lahet, C.; Mornex, R. (Univ. Claude Bernard, Lyon). pp 52-63 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In French).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

An attempt has been made to exploit the metabolic effect of lithium administration on the thyroid gland (retention of both inorganic and hormonal iodine within thyroid tissue) in the radioiodine treatment of Grave's disease (where the biological half-life is short) and in patients with iodine concentrating thyroid metastases. In this way, the maximum radiation dose for minimum administered dose of radioiodine can be obtained. A method for calculating the therapeutic dose is described. These patients show a biphasic retention curve, which can be resolved into two exponential components. Studies of a number of patients before and during lithium administration enabled the calculation of the fraction of the radioiodine dose necessary to give 8000 rads to the thyroid gland. The mode of action of the lithium is discussed taking into account factors such as the serum concentration of lithium required to produce the maximum effect on the uptake curve, the minimal duration of treatment, and the possible use of lithium in the treatment of patients requiring radioiodine treatment. (auth)

33533 ARE THERE LATE EFFECTS OF ^{131}I THERAPY OF MILD THYROID DISEASES: AN UNRESOLVED DOSIMETRY PROBLEM. Falkensammer, M.; Ladurner, D.; Riccabona, G. (Chirurgische Univ. and Medizinische Univ., Innsbruck). pp 64-73 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Eight hundred twenty two patients treated with ^{131}I between 1960 and 1968 for non-malignant diseases of the thyroid gland were re-examined to determine whether an exact dose-response relationship exists between ^{131}I dose and frequency of hypothyroidism. As criteria, clinical and laboratory findings were used as well as the measured retention of the dose one month after therapy, on which the calculation of effective radiation dose was based. The latter was compared with that calculated from dosimetric formulas (Oeser et al. 1961) or estimated from the treat-

ment plan (Chapman 1962). The follow-up studies revealed an overall incidence of hypothyroidism of 10.4%, though patients treated more than 7 years previously showed an incidence of 27.9%. Dose retention measurements showed no significant differences from those predicted regarding the initially measured thyroidal half lives, but all doses delivered were greater than planned. Diffuse hyperthyroid glands should have received 6,000 to 10,000 rep., whereas actually they received a mean dose of 21,500 rep, the incidence of hypothyroidism in patients treated more than 7 years previously being 53.5%. Nodular hyperthyroid glands should have received 10,000 to 15,000 rep., whereas actually they received a mean dose of 19,100 rep. The incidence of hypothyroidism in patients treated more than 7 years previously was 22.9%. Toxic adenomas should have received 30,000 rep., whereas actually they received a mean dose of 55,000 rep, the incidence of hypothyroidism in patients treated more than 7 years previously being 4.8%. Euthyroid goiters should have received 12,000 to 15,000 rep, whereas actually a mean dose of 18,000 rep. was applied. The incidence of hypothyroidism in such patients treated more than 7 years previously was 37.5%. These findings demonstrate that the largest source of error in the estimation of radiation dose to the thyroid in ^{131}I therapy is not the estimation of thyroidal effective half-life but the estimation of the gland weight from the scintigram or by palpation. (auth)

33534 AUTORADIOGRAPHIC AND HEMATOLOGICAL FINDINGS IN HIGH-DOSE ^{35}S THERAPY OF CHONDRO-SARCOMAS. Loebe, J.; Wohlgemuth, B. (Karl-Marx-Univ., Leipzig). pp 481-486 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Problems arising from the treatment of chondro-sarcomas with high-fractionated doses of ^{35}S are discussed with reference to autoradiography of tissue slices and hematologic findings. Granulocytes and thrombocytes show a marked reduction after each dose of ^{35}S. Autoradiography showed ^{35}S incorporation into the chondrosarcomatous region of the tumor as well as in unaffected cartilage. Ten days after administration, no radioactivity could be demonstrated in arterial walls or in the kidney indicating that there was no damage to this organ, although high ^{35}S activities were excreted by the renal route. (auth)

Animals

Refer also to abstracts 33132, 33467, and 33486.

33535 (LA-5883-PR, pp 1-22) MAMMALIAN RADIOBIOLOGY. Feb 1975.

In biomedical and environmental research program of the LASL Health Division. Annual report, January–December 1974.

The research activities of the Mammalian Radiobiology Group include: effects of internal radiation on living organisms (^{238}Pu, ^{239}Pu, ^{147}Pm, ^{210}Po, and ^{57}Co); the emphasis is on the characteristics and properties of injected microspheres; effects of ionizing radiation from external sources on living organisms; and mammalian metabolism (^{75}Se, ^{137}Cs, and ^{133}Ba). (ERB)

33536 (ORNL-5016, pp 10-11) EFFECTS OF ^{239}Pu ON CARP EMBRYOS. Eyman, L. D.; Frank, M. L.; Trabalka, J. R. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

Gametes from male and female fish were mixed in spring water containing various concentrations of ^{239}Pu. Eggs and water were collected periodically for alpha counting and autoradiography. Results indicated no significant effects of ^{239}Pu on fish embryos for effects expressed at the time of hatching. (HLW)

33537 ELECTRON-MICROSCOPIC AND ISOTOPIC EVIDENCE FOR A DIFFERENCE BETWEEN THE RADIOBIOLOGICAL EFFECTS OF IODINE-131 AND IODINE-125. Lewitus, Z.; Rechnic, J. (Beilinson Hospital, Tel-Aviv, Israel). pp 44-51 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

It has been generally accepted that the low-energy radiation emitter ^{125}I will deliver less radiation damage than an identical amount of ^{131}I. Experimental and clinical evidence has shown that, at least for the thyroid, these theoretical computations are not valid. There are, however, no practical means for determining energy deposition in the cell. A method to provide experimental evidence for the difference in the RBE of these two isotopes has been developed. Wistar rats, in groups of 10, were injected with identical amounts of the two isotopes in doses varying from 10 to 120 μCi. Various parameters of thyroid function, e.g. the weight of the gland, radioiodine uptake, PBI-131, conversion ratio, and responsiveness to a goitrogen, were determined. Electron-microscopy was utilized after intervals ranging from 8 to 100 days for comparison of the damage. The first signs of injury, manifested as a decrease in radioiodine uptake seen after 8 days, was found to be elicited by smaller amounts of ^{125}I than of ^{131}I. However, the turnover of iodoproteins was higher in the animals treated with ^{125}I than in both those treated with ^{131}I and the controls. From the 8th day, there was also an increase in weight of the glands, which reached a peak at about 90 days and then decreased to the pre-treatment level. The rats treated with ^{125}I plus a goitrogen responded with a hyperplasia of the gland, as did the controls, while those of the ^{131}I groups did not. These results support the view that ^{125}I exhibits a greater biological effect on the thyroid than ^{131}I and specifically damages the potency of normal hormone synthesis. (auth)

Plants

Refer also to abstract 33139.

Microorganisms

Refer also to abstract 33137.

33538 (BNWL-1950(Pt.2), pp 21-61) POTENTIAL FOR PLUTONIUM COMPLEXATION IN SOIL AND UPTAKE BY PLANTS. Dec 1974.

In Pacific Northwest Laboratory annual report for 1974 to the USAEC Division of Biomedical and Environmental Research. Part 2. Ecological Sciences.

Results are reported from studies on the effects of ^{238}Pu and ^{239}Pu on the soil microbial population and on soil microbial processes, the potential for formation of Pu complexes in soil and the role of the soil microflora in these processes, the extent of plant uptake and translocation of Pu or its complexes, and the bond types and chemical forms of Pu or its metabolites in microbial and plant tissues and soils. Data are reported from a study on the characteristics of Hanford soils and Columbia River sediments in relation to the distribution and retention of pertechnetate, iodide, and methyl iodide. The distribution of ^{99m}Tc in soybean plants during growth in soil containing Tc at different levels was measured. The distribution of Hg in water, suspended matter, and sediments of the lower Columbia River watershed was measured in relation to water temperature and flow at various seasons. A method was developed to determine the content of toxic methyl mercury in fish tissues. The deposition of Pu aerosols on the leaves of plants, foliar uptake and translocation, and the effects of various wind speeds on the resuspension of Pu from leaf surfaces were studied using ^{238}Pu aerosols and bean plants (Phaseolus vulgaris). The uptake of ^{137}Cs and ^{90}Sr from Hanford soils by tumbleweed was studied in relation to the evaluation of radioactive waste storage systems for liquid wastes. (CH)

Nuclide Kinetics and Toxicology

Refer also to abstracts 32625 and 33139.

Man

Refer also to abstracts 32667, 32995, 33629, 33635, and 33678.

33539 (BARC-748) PLUTONIUM IN HUMAN LUNGS: ASSESSMENT WITH THIN NaI(Tl) DETECTOR SYSTEMS. Sharma, R. C.; Somasundaram, S.; Surendran, T.; Kapur, D. K.; Garg, S. P. (Bhabha Atomic Research Centre, Bombay (India)). Health Physics Div J. 1974. 29p. Dep. NTIS (US Sales Only) $4.50.

The development of detector systems for assessment of inhaled Plutonium–Americium dust deposited in human lungs by external detection of the low-energy photons emitted, is a continuing programme at Trombay. This paper describes the work done with thin NaI(Tl) scintillation detector systems. The background data inside Trombay steel room in different low-energy bands for crystals of thicknesses 1, 2, and 5 mm are presented. To study the capabilities of three detector systems, each consisting of a set of crystals of the same thickness, a realistic chest phantom of an Indian adult was designed and employed. The chest phantom was constructed from the rib cage taken out of the cadaver of an Indian adult. It was enclosed in a hard polythene cover to simulate the chest profile. Measurements were made on the absorption and scattering of low-

energy photons (17, 22, and 60 keV) by four constructional materials in order to verify their degree of equivalence to human tissue and granular sugar was chosen as tissue-equivalent material in phantom construction. The counting efficiencies and limits of detection of the three detection systems for point sources of plutonium distributed in the central plane of each lung of the phantom were studied. A few normal subjects were counted with one of the detector systems and the increase in background in the low-energy region was investigated. The natural and acquired radioactivity of each subject was monitored with a (20.32 cm dia × 10.16 cm thick) NaI(Tl) crystal in a 50 cm arc chair geometry. Finally, the effect of body build of a subject on the counting efficiency of plutonium is commented upon and our future program is briefly indicated. (auth)

33540 (LA-tr-75-6) RADIATION DOSE RECEIVED BY HUMANS FROM INTRAVENOUSLY ADMINISTERED SODIUM SELENITE MARKED WITH SELENIUM-75. Falk, R.; Lindhe, J. C. (Statens Straalskyddsinstitut, Stockholm (Sweden)). 1972. Translation of Straldosen till Maenniska fran Intravenoest Administrerad Natriumselenit Maerkt md Selen-75. (SSI-1974-011). 30p. Dep. NTIS $4.50.

The retention history of ^{75}Se in the body was approximated with 2 exponential terms. About 10% of the administered amount is excreted during the first day, after which 40% is excreted with a biological half-life of 20 days, and 48% with a biological half-life of 115 days. The retention history of ^{75}Se in the blood can also be described by a two-phase exponential sequence with biological half-lives of 5 and 97 days, respectively. Data from other studies showed that Se-methionine is excreted more slowly than sodium selenite. Because the absorption in the kidneys and liver are different for the 2 Se compounds the radiation dose received is greater if the ^{75}Se is administered in the form of sodium selenite than if it is administered as methionine. (HLW)

33541 (NP-20366) TOXICITY OF PLUTONIUM. (Medical Research Council, London (UK)). 1975. 43p. Dep. NTIS (US Sales Only) $5.25. UK 45 pence.

The subject is considered under the following headings: ICRP recommendations for maximum permissible annual dose and maximum permissible annual intake; dose commitment in bone; relevant tissues in lung and other thoracic organs; the hot particle problem; dosimetry of plutonium; relative risks for irradiation of different tissues and at different ages; and numerical estimates of risk. (UK)

33542 FACTORS USED FOR THE ESTIMATION OF RADIOACTIVE NUCLIDE INTAKE THROUGH FOODSTUFFS BY INHABITANTS IN COASTAL AREA OF IBARAKI PREFECTURE. I. Leaf Vegetable Consumption in Kuji Town and Tokai Village and Measurement of Dimensions of the Leaves. Ohmomo, Y.; Sumiya, M.; Hirano, K.; Nakayama, M.; Sumiya, F. (National Inst. of Radiological Sciences, Chiba (Japan)). Hoken Butsuri; 9: No. 2, 99-107 (Jun 1974).

The consumption of leaf vegetables was surveyed on three kinds of families in Kuji town and Tokai village. The average daily intake through a year was 116, 115, and 132 g/d/p for fisherman's families in Kuji, native's in Tokai and immigrant's from city to Tokai village, respectively. High consumption of leaf vegetables was observed in autumn and winter, and less consumption in summer. All year round cabbage and Welsh onions were consumed, in summer lettuce, and from autumn to spring Chinese cabbage and spinach. The average daily intake of each leaf vegetable relating to the deposition of gaseous iodine-131 were also measured. (auth)

33543 FACTORS USED FOR THE ESTIMATION OF RADIOACTIVE NUCLIDE INTAKE THROUGH FOODSTUFFS BY INHABITANTS IN COASTAL AREA OF IBARAKI PREFECTURE. II. Consumption of Fruit Vegetables, Flower Vegetables and Mushrooms in Kuji Town and Tokai Village. Ohmomo, Y.; Sumiya, M.; Hirano, K.; Nakayama, M.; Sumiya, F. (National Inst. of Radiological Sciences, Chiba (Japan)). Hoken Butsuri; 9: No. 2, 109-115(Jun 1974).

The consumption of fruit vegetables, flower vegetables, and mushrooms was surveyed on three kinds of families in Kuji town and Tokai village. Very high consumption was observed in summer contrasting with the case of leaf vegetables. The average daily intake of those through a year was 68, 98, and 65 g/d/p for fisherman's families in Kuji, native's and immigrant's in Tokai, respectively. Nearly all the year round cucumber was consumed at a high level, followed by beans sprouts and sweet pepper at a lower consumption, in summer eggplant and tomato, and from autumn to winter cauliflower. It was also recognized that the consumption frequency of fresh "Shiitake" was considerably high though the consumption rate was not so high. (auth)

33544 A NEW COMPUTATIONAL MODEL FOR DEPOSITION OF AEROSOL PARTICLES INHALED IN HUMAN RESPIRATORY SYSTEMS. Takahashi, K. (Kyoto Univ., Uji (Japan). Inst. of Atomic Energy); Ito, H. Hoken Butsuri; 9: No. 1, 3-10(Mar 1974). (In Japanese).

A new computational model for deposition of particles inhaled in human respiratory systems is proposed. Weibel's model was used as a standard human lung. Calculations were performed by a method similar to Landahl's, Beeckmans' and others', with the exception of newly proposed equations for the particle deposition by impaction in the diverged parts and by tranquil diffusion in the straight parts. The calculated results were somewhat different from the ICRP's, and some examples of regional distributions of particle deposition in human lung were shown. (auth)

33545 METHOD OF MONITORING FOR INTERNAL CONTAMINATION OF THE STAFF IN THE INSTITUTE OF NUCLEAR RESEARCH, BASED ON THE MEASUREMENTS OF RADIATION EMITTED BY THE ORGANISM. Cwik, T.; Deszczak, T. (Institute of Nuclear Research, Warsaw (Poland)). Probl. Tech. Med.; 4: 311-316(1973). (In Polish).

From 3rd symposium of Polish Medical Physics Society; Zabrze, Poland (10 May 1972).

The general parameters of equipments and the measurement methods are presented—used in the Institute of Nuclear Research for the determination of internal contamination of the staff by gamma radiation emitters. The monitoring program in such cases is discussed together with measurement methods. (auth)

33546 DISTRIBUTION OF ^{11}C–CHLORPROMAZINE IN MAN. Comar, D.; Maziere, M.; Raynaud, C. (Hopital d'Orsay, France). pp 81-89 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In French).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Numerous studies of the metabolism and the distribution of ^{14}C- or ^{35}S-chlorpromazine in animals revealed considerable affinity of this substance for brain, lung, and adrenal gland tissue. The only possible way to take advantage of this behavior for medical diagnosis is to use ^{11}C as a tracer. Since this radionuclide is a positron emitter yielding annihilation radiation of 511 keV, it may be detected externally. It may also be used for high specific activity labelling. Chlorpromazine was labelled with ^{11}C on the terminal methyl group of the lateral chain of the phenothiazine ring by treating nor-chlorpromazine with ^{11}C-formaldehyde. The product is theoretically obtained carrier-free. Despite the fact that the molecule is degraded by demethylation the rate of this process is slow when compared with the physical half-life of ^{11}C of 20 minutes. Distribution studies in man were performed after preliminary studies in mice, rabbits, and primates. After intravenous injection of 0.5 to 2.0 mCi ^{11}C-chlorpromazine, sequential images of the head, thorax, and kidney regions were obtained for about 1 hour by means of a scintillation camera fitted with a high energy collimator. The results obtained justify the interest in neuroleptic agents labelled with ^{11}C for medical diagnosis. (auth)

33547 MEASUREMENT OF THE MYOCARDIAC FIXATION RATE USING ^{131}Cs (FIRST RESULTS). de Vernejoul, P. (Groupe Hospitalier Necker-Enfants Malades, Paris); Fauchet, M.; Mestan, J.; Valeyre, J. pp 519-522 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In French).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Measurement of the rate of myocardial fixation of ^{131}Cs by external counting permits quantitative evaluation of the functional state of myocardial tissue. Taking into account the physical characteristics of ^{131}Cs, there are certain precautions which must be taken in expressing the experimental results in terms of percentage of injected dose per 100 g myocardium. Preliminary results are presented. (auth)

33548 BONE TUMOR IMAGING WITH ^{169}Yb-CITRATE. Tatsuno, I.; Bunko, H.; Kato, S. (National Hospital of Kanazawa (Japan)). Kaku Igaku; 11: No. 4, 471-478(Aug 1974). (In Japanese).

Use of ^{169}Yb-citrate as a bone imaging agent rather than tumor imaging agent is discussed. One autopsy case who died 19 days after ^{169}Yb-citrate tumor imaging was intended occurred and ^{169}Yb-citrate was administered intravenously. It was confirmed that ^{169}Yb-citrate accumulated chiefly in the bones (500-600 times of blood activity). From these results, ^{169}Yb-citrate was used in detecting malignant bone lesions for localization of radiation therapy of these lesions. Bone imaging was taken 2 to 5 days after injection of 200 to 300 μCi of ^{169}Yb-citrate intravenously. Forty-five bone lesions were imaged and nineteen lesions were detected by x-ray photo (x-p) and/or ^{169}Yb-

citrate imaging. These nineteen lesions were confirmed either by biopsy, operation, or autopsy. Seventeen of these 19 lesions were detected by ^{169}Yb imaging (89.5%); of these 17, 15 (88.2%) revealed abnormal ^{169}Yb accumulation and 2 (11.8%) revealed abnormal ^{169}Yb defects. Fifteen lesions (79.0%) were detected by x-p and thirteen (68.4%) by both x-p and ^{169}Yb imaging. To compare x-p with ^{169}Yb imaging in detecting these lesions, 8 (42.1%) were equally detected by each method and in 8 (42.1%) ^{169}Yb imaging exceeded x-p and in 3 (15.8%) x-p exceeded ^{169}Yb imaging. After radiation therapy, ^{169}Yb accumulation decreased. From a standpoint of radiation dose to skeletal system, large dose cannot be administered but selection of cases makes the nuclide to be relatively low-dose and useful bone seeking agent. (auth)

33549 CLEARANCE OF RADIOACTIVE AEROSOLS IN THE HUMAN LUNG. Hamano, S.; Inoue, H.; Iio, M.; Matsuda, Y. (National Sanatorium of Nakano, Tokyo (Japan)). Iryo; 28: No. 7, 549-555(Jul 1974). (In Japanese).

Deposition and clearance of inhaled particles of water solution of Au and Tc were studied in normal subjects and patients with various pulmonary disease. For this purpose, heterodisperse aerosols of particles were produced in an ultrasonic nebulizer. Thoracic counts and images with a Gamma camera were obtained after inhalation of the aerosol and some cases were examined from beginning of inhalation. Results are as follows: (1) We compared the patterns of deposition and clearance observed in normal subjects and pulmonary patients. The difference of clearance among pulmonary diseases was not detectable by the methods used, because the deposition pattern of particle in the lung was varied by underlying disease. (2) Between smokers and non-smokers who showed similar deposition patterns, there were marked differences in their clearance. Tracheobronchial clearance in non-smokers occurred immediately after inhalation, but in smokers clearance was delayed two-hours after inhalation. (auth)

33550 CONCENTRATION OF PLUTONIUM IN JAPANESE HUMAN BONE. Okabayashi, H.; Watanabe, H. (National Inst. of Radiological Sciences, Chiba (Japan)). J. Radiat. Res.; 14: No. 4, 363-368(Dec 1973).

Results of measurement of plutonium in Japanese human bone samples collected in four cities are presented. This measurement was done in connection with the nuclear explosion tests conducted since 1962. The results show that the concentration of plutonium in human bone increased yearly from 1962 through 1971, and the average concentration in 1971 was 4×10^{-15} Ci per one gram of bone. Any difference due to the sampling place, sex, or age has not been detected in the plutonium concentration in bone. It is of significance to note that the transfer of plutonium to fetus was recognized. The amount of plutonium deposited in bone showed a closer relation to the concentration of plutonium in air than in diet. It is estimated by using the equation of ICRP (1959) that the radiation dose delivered to bone is 16.3 mrem/year at the radioactivity level in 1971. (auth)

Animals

Refer also to abstracts 32511, 33111, 33132, 33138, 33140, 33486, 33487, 33535, and 35686.

33551 PITUITARY $^{45}C^{++}$ UPTAKE AND RELEASE OF ACTH, GH, AND TSH: EFFECT OF VERAPAMIL. Eto, S.; Wood, J. M.; Hutchins, M.; Fleischer, N. (Albert Einstein Coll. of Medicine, Bronx, NY). Amer. J. Physiol.; 226: No. 6, 1315-1320(Jun 1974).

Potassium (57mM) or ouabain (1×10^{-3} M) added to the incubation medium of rat pituitary tissue produced increased pituitary total calcium as well as accumulation of $^{45}Ca^{++}$ and the release of adrenocorticotropin (ACTH), growth hormone (GH), and thyrotropin (TSH) into the medium. Verapamil (5×10^{-5} M), an agent that inhibits calcium current, inhibited this $^{45}Ca^{++}$ accumulation and the release of ACTH, GH, and TSH. These data indicate that pituitary calcium uptake is vital for hormone release induced by potassium or ouabain. Verapamil had no effect on ACTH release induced by crude hypothalamic extracts, synthetic lysine vasopressin, dibutyryl cyclic AMP, or theophylline. Verapamil did not inhibit TSH release induced by synthetic thyrotropin-releasing factor or GH release induced by crude hypothalamic extracts. None of the latter secretagogues produced an observable increase in pituitary levels of labeled calcium. It is concluded that hypothalamic-releasing factors and their intermediates do not affect the process of stimulus-secretion coupling by promoting a specific calcium influx, whereas ouabain and potassium do affect it. (auth)

33552 SIMULTANEOUS MEASUREMENT OF BLOOD FLOW AND OF RADIOIODINE ACCUMULATION IN THE THYROID OF RATS. Jahoda, I.; Kapitola, J. (Karlova Universita, Prague (Czechoslovakia). Fakulta Vseobecneho Lekarstvi); Englich, J. (Karlova Universita, Prague (Czechoslovakia). Fakulta Matematicko-Fyzikalni). Cesk. Fysiol.; 23: No. 2, 175-176(May 1974). (In Czech).

A method is described of simultaneous measuring the blood flow and the radioiodine accumulation in the rat thyroid, based on simultaneous determination of ^{86}Rb and ^{131}I in the sample. It was ascertained that applying the method, results could be achieved with the maximum relative error not exceeding 5%. The method was found to be especially suitable for investigation of the time variation of the two indices in relation to the experimental conditions and effects. (INIS)

33553 CONTAMINATION OF ARENICOLA MARINA L. BY CESIUM-137 IN TERMS OF SEXUAL MATURITY AND SEX. Amiard-Triquet, C. (Univ., Nantes, France). Ann. Inst. Oceanogr. (Paris); 50: No. 1, 67-70(1974). (In French).

Contamination of the coelomic fluid was stronger during the reproduction stage than during sexual rest, radiocesium being concentrated by the genital products found in the coelomic fluid. The contamination of the spermatozoids was higher than that of the ovules. Concentration of ^{137}Cs in the other organs was not affected by sexual maturity. (FR)

33554 DISTRIBUTION OF TOTAL STRONTIUM-90 IN THE SKELETON AND TEETH OF THE ADULT WILD BOAR IN THE KARAKALPAK SSR. Rahimov, Z. R. Sb. Rab., Leningrad. Vet. Inst.; No. 33, 275-277(1973). (In Russian).

Studies were performed on the concentrations of ^{90}Sr in five types of bone and teeth of the wild boar (5 to 6 years old). Lowest ^{90}Sr concentrations were found in the ribs, atlas, lower jaw, and the epiphysis. Highest ^{90}Sr concentrations were found in the molar teeth, and lowest in the incisors; the concentration was greater in the lower tusks than in the upper tusks. (Referativnyi Zh.)

33555 ALVEOLAR DEPOSITION OF INHALED PLUTONIUM AEROSOLS IN RODENTS. Craig, D. K.; Buschbom, R. L. (Battelle Pacific Northwest Labs., Richland, WA). Amer. Ind. Hyg. Ass. J.; 36 No. 3, 172-180(Mar 1975).

The alveolar burden following nose-only aerosol exposure of rodents to highly toxic radioactive materials depends upon the percentage of the inhaled aerosol that is deposited beyond the animals' ciliated epithelium. The quantity inhaled was estimated from the product of the aerosol concentration (nCi/liter), the exposure time (minutes), and the mean minute volume (liters/min) of the animals. For rats exposed to $Pu(NO_3)_4$ and sacrificed within an hour, the mean alveolar deposition was 19.2 ± 9.19% for 36 groups of both ^{239}Pu and ^{238}Pu. No important correlations between any of the measured parameters and this initial percentage deposition were observed, in contrast with the results for $^{239}PuO_2$ deposition measured in rats sacrificed 24 or 48 hours postexposure. In these, the aerosol activity median aerodynamic diameter (AMAD) was strongly correlated with aerosol concentration and percentage deposition (mean —7.9 ± 3.9% for 32 groups) with AMAD over the range of 1.5 to 4.5 μm. The 200-fold lower mass concentration of ^{238}Pu compared with ^{239}Pu for a given activity level may explain the fact that the AMAD was correlated with concentration for ^{239}Pu oxide and nitrate, but not for ^{238}Pu compounds. (auth)

33556 ELECTRON DIFFRACTION STUDY OF PLUTONIUM OXIDE PARTICULATES IN DOG LYMPH TISSUE. Hillyer, R. F.; Dagle, G. E. (Dow Chemical U. S. A., Golden, CO). pp 197-205 of Microstructural Science. Volume II. Fritzke, G. P.; Richardson, J. H.; McCall, J. L. New York; American Elsevier Publishing Co., Inc. (1974).

Popliteal lymph-node sections from beagle dogs were examined with the electron microscope in order to define localized particulates. By means of autoradiography, particulates in the lymph tissue were determined previously to be alpha emitters (radioactive). However, with electron diffraction, the particulates were identified as plutonium oxide (PuO_2). (auth)

33557 DEPOSITION OF RADIOACTIVE-LABELLED TISSUE HOMOGENATES IN VARIOUS ORGANS OF THE RAT. Kment, A.; Niedermueller, H.; Hofecker, G.; Papadopoulos, E. (Tieraerztliche Hochschule, Vienna). pp 98-106 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

The specific affinity of certain cell parts or cell fractions with regard to a homologous organ after subcutaneous application of in vivo labeled homogenates of liver, heart, and kidney was investigated. Forty male Sprague–Dawley rats (age 12 months) were used. From literature, the distribution of a labeled tissue is known not to be stochastic, but in the past there was no pos-

sibility of selective labeling (Marshak and Walker 1945, Ebert 1954, Harbers and Neumann 1954, Lettré 1955, Walter, Allmann and Mahler 1956, Schmid 1963). In 15 male Sprague–Dawley rats (age 6 weeks) the proteins, peptides, and the pool of free amino acids were labeled with L-histidine 2,5-T. On account of the labeling and the treatment of samples, the measured radioactivity is only that of L-histidine-2,5-T (Hofecker, Niedermüller and Kment 1972). The homogenates were applied subcutaneously, and 24 hours after application the recipient animals were killed. Following parameters were studied: activity in the whole organ, the blood, the blood-plasma, the cell-organelles, the cytoplasma-protein and in the cytoplasma-non-protein of liver, kidney, heart, and spleen. These results show a specific incorporation of material into the homologous organ that is biostatistically verified in most of the parameters. (auth)

33558 ABSORPTION, DISTRIBUTION, AND ELIMINATION OF ^{169}Yb-EDTA IN ANIMAL EXPERIMENTS. GFR Estimation in Rats. Molnar, G.; Pal, I.; Stutzel, M.; Szilvasi, I.; Lengyel, M. (Semmelweis Univ. of Medicine, Budapest). pp 142-151 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Ytterbium-169-labelled EDTA was administered into the stomach of guinea pigs; no absorption could be found. The peritoneal absorption of ^{169}Yb-EDTA in rats was excellent; this route of administration can be used instead of I.V. injection. The volume of distribution of ^{169}Yb-EDTA was found to be 21.3% of body weight in nephrectomized dogs, and 29% of body weight in normal rats. The plasma elimination curve of ^{169}Yb-EDTA is consistent with a two-compartment system in dogs. The fast slope corresponds practically to the distribution. The average GFR value expressed in ml/min. 100 g body weight was 0.55 ± 0.019 (SE) in male and 0.61 ± 0.018 (SE) in female rats. The elimination rate of ^{169}Yb-EDTA from the blood was twice higher in rats than in normal human subjects. The single shot technique for GFR estimation seems to be suitable in small animals, too. (auth)

33559 ^{99m}Tc–DTPA (Sn): BIOLOGICAL AND CLINICAL STUDY ON THE DISTRIBUTION, KINETICS, AND IN-VIVO STABILITY OF A NEW CLEARANCE SUBSTANCE. Heidenreich, P.; Kriegel, H.; Hoer, G.; Goeger, H.; Keyl, W.; Schramm, E. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Munich). pp 174-185 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Biological distribution studies of ^{99m}Tc-DTPA were carried out in 256 male and female rats aged between 45 and 70 days. A control group of 256 rats were injected with ^{99m}Tc-pertechnetate. The animals were killed at intervals of 5, 10, 20, 40, 60, 100, and 120 minutes after injection, and radioactivity of blood, kidney, liver, spleen, thyroid, bone marrow, muscle, and femur was measured. The blood clearance of ^{99m}Tc-DTPA is biphasic over a period of 120 minutes with a half time for a fast initial component of 12.1 minutes and 30.6 minutes for the slow component. Results for the ^{99m}Tc-DTPA complex in thyroid, femur, testis, and kidney showed that clearance ran a parallel course to blood. In kidney, liver, spleen, and bone marrow, this was not the case. The complex is chemically stable, with a concentration of ^{99m}Tc in the thyroid gland of less than 1%. Blood clearance measurements showed a distribution volume of 18.7 ml/100 g rat. Observed differences between young and old rats could be accounted for by a body weight correction, but significant differences due to age and sex were observed in the femur and gonads. In addition, 46 patients were examined using simultaneous clearance measurements of ^{99m}Tc-DTPA and ^{125}I-sodium iothalamate; this comparison gave a correlation coefficient of 0.92. These results suggest that ^{99m}Tc-DTPA is a useful radiopharmaceutical for the measurement of glomular filtration rate. Furthermore, the whole-body counter, described by Oberhausen can also be used. (auth)

33560 DEPENDENCE OF THE RELATION OF ^{113}Sn/^{113m}In IN BONES IN COMPARISON WITH ^{47}Ca AND ^{85}Sr. Grimm, W.; Kaufmann, A.; Kutzner, J. (Univ., Mainz). pp 314-320 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

In studies of the uptake of ^{113}Sn-^{113m}In in rat bone, no establishment of equilibrium between the mother–daughter pair was found. After the incorporation of ^{113}Sn in the bone structure, ^{113m}In was removed in varying degrees by the blood and excreted in the urine. The removal of ^{113m}In amounted to between 3% and 25%, with a mean value of 11%, and is probably a function of bone vascularization. Studies of the incorporation of ^{113}Sn, ^{113m}In, ^{47}Ca, and ^{85}Sr in various regions of the skeleton, as well as the removal of ^{113m}In, showed a broadly similar distribution of these bone-seeking isotopes, but marked differences in relative uptake in different bones. (auth)

33561 ANIMAL EXPERIMENTAL RESULTS ON THE MODIFICATION OF THE ACCUMULATION BEHAVIOR OF ^{18}F IN BONES BY FLUORIDE AND EDTA. Beska, F.; Georgi, P.; Sinn, H.; Wesch, H. (Deutsche Krebsforschungszentrum, Heidelberg). pp 487-489 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Premedication with NaF and EDTA has no specific influence on the accumulation of ^{18}F in the bone. The behavior of the normal and the fractured tibia is nearly the same. The difference in the accumulation of ^{18}F in the normal and the pathologically changed bone tissue also remains constant. (auth)

33562 HYGIENIC CHEMICAL STUDIES ON SELENIUM COMPOUNDS. I. Retention, Distribution and Elimination of Sodium ^{75}Se-Selenite After Repeated Oral Administration in Rats. Hasegawa, A.; Suzuki, Y.; Urakubo, G. (National Inst. of Hygienic Sciences, Tokyo(Japan)). Eisei Kagaku; 20: No. 2, 67-74(Apr 1974). (In Japanese).

Absorption, elimination, and distribution of radioactive selenium were examined after a long term repeated oral administration of sodium ^{75}Se-selenite (0.03 mg/kg/day) in male rats. Oral administration of the compound and measurement of radioactivities in the whole body of living animals, in feces and urine just before each dosing, were continued every day for approximately 90 days, using a Packard ARMAC scintillation counter. The whole-body count of ^{75}Se increased rapidly during the initial 10 days and thereafter continued to increase rather slowly and linearly. Radioactivity was excreted mainly via urine and a small amount in feces. After the termination of repeated administration of sodium ^{75}Se-selenite for 90 days, elimination of ^{75}Se was rather rapid for 10 days, and later, it continued slowly and the whole-body count decreased along an exponential line. Therefore, linear retention line of selenium was depicted graphically on a semi-logarithmic scale. Biological half-life of absorbed labeled selenium in the whole body, calculated from this line, was 26.4 days. Biological half-life of ^{75}Se in each organ and tissue was also calculated as follows: sodium ^{75}Se-selenite (0.03 mg/kg/day) solution was given to a number of rats by repeated daily administration for 15 days, and the distribution pattern was observed at 4, 22, 39, and 65 days after termination of administration and the γ activities were measured in 17 kinds of organs and tissues with well-type scintillation counter. The values obtained were 36 days for hair, 29.9 days for thyroid, 26.9 days for pituitary, all longer than the value in the whole body. By the repeated administration of sodium ^{75}Se-selenite for 35 and 90 days, remarkable accumulation of ^{75}Se was found in the epididymis, kidney, liver, and testis, but the content of ^{75}Se in the liver and testis decreased significantly 65 days after the termination of administration. (auth)

33563 EXPERIMENTAL STUDIES ON THE ABSORPTION AND EXCRETION OF CADMIUM. Shibata, H. (National Inst. of Radiological Sciences, Chiba (Japan)). Radioisotopes (Tokyo); 22: No. 12, 694-700(Dec 1973). (In Japanese).

This study was undertaken to clarify the absorption and excretion of cadmium in the body. The excretion into the feces and urine, the absorption and excretion through the gastrointestinal tract, and the distribution of ^{109}Cd were investigated in mice by means of the sample measurement and the whole-body autoradiography. Orally administered $^{109}CdCl_2$ was poorly absorbed from the gastrointestinal tract into the body and the greater part of the ^{109}Cd was excreted into the feces. Intravenously injected $^{109}CdCl_2$ was excreted into the gastrointestinal tract through the gastrointestinal wall and the bile duct, and excreted into the feces. In either oral administration or intravenous injection, the ^{109}Cd was excreted into the urine a little. To compare the absorption and excretion in each gastrointestinal tract divided into 10 parts, ^{109}Cd was relatively well absorbed in the lower part of small intestine, and excreted in the middle and lower part. The ^{109}Cd absorbed into the body was distributed to the liver, kidney, gastrointestinal wall, pancreas, salivary gland, and other tissues. It is concluded from the results obtained that the greater part of ingested cadmium (inorganic cadmium) is excreted into the feces and a little part of it is absorbed into the body, and a little part

of the absorbed cadmium is excreted into the gastrointestinal tract and subsequently excreted into the feces. (auth)

33564 CESIUM-137 CONTAMINATION OF MARINE FISHES FROM THE COASTS OF JAPAN. Suzuki, Y.; Nakamura, R.; Ueda, T. (National Inst. of Radiological Sciences, Chiba (Japan)). J. Radiat. Res.; 14: No. 4, 382-391(Dec 1973).

The uptake and accumulation of cesium-137 by fishes from sea water was studied through the field studies for eight years (1963 to 1970). The concentration of cesium-137 in marine fish muscles decreased with time after 1963, and the concentration factors ranged from 11 to 81. On the other hand, the concentration factors of stable cesium remained in a narrow range between 34 and 52. The mean value of the observed ratio (OR) calculated by cesium-137 and potassium was 5.7 during the period from 1964 to 1970, and the OR value based on stable cesium was 5.9. The ratios between annual mean values of the specific activities of fish muscles and of sea water were found to be from 0.6 to 1.5. From these data, if the concentration of cesium-137 in the environmental sea water is known, it is possible to estimate the approximate concentrations of cesium-137 in marine fishes by using the concentration factor or observed ratio without any analytical procedures. (auth)

33565 IN VIVO DISTRIBUTION OF ^{103}Ru-RUTHENIUM RED. Anghileri, L. J. (Univ., Essen). J. Nucl. Biol. Med.; 18: No. 4, 155-159(1974).

The in vivo distribution of ^{103}Ru-ruthenium red in normal and in tumor bearing animals was studied. Tumor bearing mice excrete more of this compound than normal animals. In comparison with $^{103}RuCl_3$, which is considerably less excreted, this ionic complex is taken up to a much lesser extent by the bone. Its distribution pattern is in accordance with its specific binding to muco-proteins and mucopolysaccharides. This radioactive compound exhibits potential value as a tool to study disorders of mucopolysaccharide metabolism. (auth)

Plants

Refer also to abstract 35687.

33566 (CEA-CONF-2919) FATE OF OXYGEN IN PHOTOSYNTHESIS. Gerster, R.; Dimon, B.; Peybernes, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France). Service de Radio-Agronomie). 1974. 13p. (CONF-740946-5). Dep. NTIS (US Sales Only) $4.00.

From 3rd international congress on photosynthesis; Rehovot, Israel (2 Sep 1974).

Measurements of O_2 uptake during photosynthesis were carried out by observing the disappearance of the $^{18}O_2$ and $^{16}O^{18}O$ added to the atmosphere. The action spectrum of this process and of the CO_2 compensation point were determined on soybean; no chromatic effect was observed between 430 and 650 nm. Furthermore, the appearance of ^{18}O in the CO_2 evolved from algae and leaves exposed to light and $^{18}O_2$ have also been followed; two oxygen atoms of the CO_2 became labelled simultaneously when isotopic exchange reactions between CO_2 and water were slowed down. These latter results cannot be explained by the classical schemes describing the source of photorespiratory CO_2. (auth)

33567 STUDIES ON THE RADIOACTIVE CONTAMINATION OF FRUIT TREES BY FISSION PRODUCTS. IV. ^{90}Sr Distribution in Fruit of the Satsuma Orange Trees Grown at an Orchard. Shiraishi, Y. (National Inst. of Radiological Sciences, Chiba (Japan)). J. Radiat. Res.; 14: No. 4, 392-398(Dec 1973).

The distribution of fallout ^{90}Sr in the skin, juice, and residue part of the mature fruit of Satsuma orange trees grown on soils under clean, mulch, and sod systems of soil management was investigated for the years from 1961 through 1971. The level of this nuclide in the skin showed a high concentration during the period of heavy fallout deposition followed by a slow exponential decrease with almost the same halftime as that of the replaceable ^{90}Sr content in soil. On the contrary, the level of ^{90}Sr in the juice part was not influenced by the heavy fallout deposition, and the ^{90}Sr content showed almost the same pattern as that of the replaceable ^{90}Sr content in soil between 1961 and 1971. The ratio of the ^{90}Sr content due to direct (surface) absorption including floral absorption to that due to indirect (root) absorption was 7:1 for the skin and 1:6 for the residue in 1963 when heavy fallout deposition was observed. The ratio of ^{90}Sr/Ca in plant tissues to replaceable ^{90}Sr/Ca in soil was also discussed. (auth)

33568 TRANSLOCATION AND INTRACELLULAR DISTRIBUTION OF TRITIATED GIBBERELLIN A_3. Asakawa, Y.; Tamari, K.; Inoue, K.; Kaji, J. (Tohoku Univ., Sendai (Japan). Faculty of Agriculture). Agr. Biol. Chem. (Tokyo); 38: No. 4, 713-717 (Apr 1974).

The localization of tritium-radioactivity in dwarf kidney bean plants (Phaseolus vulgaris) of ^{3}H-gibberellin A_3 (^{3}H-GA_3) applied in a large quantity was investigated in advance of the study on GA_3 metabolism in this plant. Immediately after the application of ^{3}H-GA_3, the radioactivity was distributed uniformly in the top of this plant; no further transportation of the radioactivity into the growing apical region from mature leaves and stems was observed as the growth stage proceeded. An investigation on the intracellular localization of the radioactivity demonstrated that most part of the radioactivity was found in the cellular soluble fraction, while no radioactivity was detected in such subcellular particles as nuclei, mitochondria, and microsomes. Examinations of the occurrence of GA_3 bound with such macromolecules as RNA and protein gave negative results. (auth)

Microorganisms

33569 (ORNL-tr-2911) EFFECT OF PHYTOPLANKTON ON PHYSICO-CHEMICAL STATE OF ^{239}Pu, ^{106}Ru, ^{99}Tc, AND ^{60}Co IN OCEAN WATER. Gromov, V. V. Translated by M. Gerrard (Oak Ridge National Lab., TN), from Dokl. Akad. Nauk SSSR; 215: No. 2, 451-453(1974). 4p. Dep. NTIS $4.00.

The change in the physicochemical state of ^{239}Pu, ^{106}Ru, ^{99}Tc, and ^{60}Co due to their assimilation by phytoplankton was investigated. It was found that biological assimilation by phytoplankton is decisively important in the stabilization of physicochemical forms of these radioisotopes, as a result of which the state of Pu, Ru, Tc, and Co in the marine environment is altered, which in turn leads to variation in the entrapment of these elements by bottom sediment and, evidently, by suspended matter. (ERB)

33570 ^{137}Cs ABSORPTION BY KRILL. Tolkach, V. V.; Gromov, V. V.; Spitsyn, V. I. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 220: No. 1, 223-226(1 Jan 1975). (In Russian).

The uptake and elimination of ^{137}Cs by krill (Euphausia superba Dana) taken from the Ross Sea and maintained in conditions as close to natural as possible was studied. Typical curves of the assimilation of ^{137}Cs show that, independent of the age of the krill, it is almost completed within one day and reaches a steady-state condition in 1.5 days. The kinetics of absorption were determined and theoretical and experimental data agree. (JSR)

New Tracer Techniques

Refer also to abstracts 32475, 32515, 32629, 33148, 33194, 33210, 33400, 33468, 33469, 33479, 33486, 33516, 33518, 33548, 33549, 33552, and 33566.

33571 (AE-489(Vol. 2)) BONE MINERAL DETERMINATIONS. Proceedings of the Symposium Held in Stockholm-Studsvik, Sweden, 27-29 May 1974. Vol. 2. Presented Papers (Cont.) and Group Discussions. Schmeling, P. (Ed.). (Aktiebolaget Atomenergi, Studsvik (Sweden)). Dec 1974. 203p. (CONF-740566-P2). Dep. NTIS (US Sales Only) $13.25.

Separate abstracts were prepared for the 14 papers included. (CH)

33572 (AE-489(Vol. 2), pp 3-9) CHANGES IN ALVEOLAR BONE MASS FOLLOWING EXTERNAL AND INTERNAL INFLUENCES AS MEASURED BY ^{125}I ABSORPTIOMETRY. Henrikson, C. O.; Alveryd, A.; Bergstroem, J. (Karolinska Institutet, Stockholm). Dec 1974.

From symposium on bone mineral determinations; Stockholm, Sweden (27 May 1974).

In bone mineral determinations.

A monoenergetic photon attenuation technique for repeated determination of alveolar bone mineral mass in vivo has been developed. The radionuclide iodine 125, concentrated to a small radiation source, is placed intraorally and the well collimated radiation is filtered by tin to an approximately monoenergetic x-ray beam. High geometric reproducibility during the period of measurements is obtained by using the teeth as reference points for the alveolar bone. The radiation source and the collimators can be adjusted so the same part of the alveolar bone will be measured on each occasion. The apparatus can also be used to measure the thickness of the alveolar process containing bone mineral and soft tissue. Thus, the mass of the bone mineral can be determined in terms of $g \cdot cm^{-2}$. The precision over a period of 6 months expressed as the standard deviation of a single determination, was 0.003 $g \cdot cm^{-2}$ or 1%. The mean intraindividual variation between observation occasions based on the root mean square of bone mass in healthy subjects during 6 months was 0.006 $g \cdot cm^{-2}$ or 2%. This fluctuation may be explained partly by true variations in the bone mass. The mineral mass of the alveolar bone will de-

crease markedly as a consequence of trauma to the teeth or to the tissues surrounding the bone to be examined. The course of the loss of bone mineral seems to be rather independent of type of trauma. It is characterized by an initial decrease, most pronounced 3 to 4 weeks after the trauma. After this period of decrease a change in the course is observed toward higher values of the bone mineral mass until the pretraumatic level. In the case of hyperparathyroidism the alveolar bone mass will change as a consequence of the surgical treatment. In a group of five patients the alveolar bone mineral mass increased 2.0% during a six months period. The duration of the periods of demineralization (3 to 4 weeks) and remineralization (4 to 6 months) are in accordance with recent concepts of bone tissue biodynamics. (auth)

For abstracts of individual papers see: 33572–33585.

33573 (AE-489(Vol. 2), pp 10-17) GAMMA-RAY OSTEODENSITOMETRY OF THE MANDIBLE. A New Method. von Wowern, N. (Royal Dental Coll., Copenhagen). Dec 1974.

From symposium on bone mineral determinations; Stockholm, Sweden (27 May 1974).

In bone mineral determinations.

A new method for gamma-ray osteodensitometry of the incisor and premolar region of the mandible has been developed and tested. The lower part of the face is dipped into water in a container, equipped with special sticks to hold the head in an unequivocal reproducible position. The scanning is done in frontal planes through the mandible. The sum of the single scans, expressed in arbitrary units, is used as a measure for the mineral content. This can be accepted, since there is a linear correlation between the result by scanning and the ash weight ($r = +0.93$) of the scanned part of 10 different mandibular post mortem specimens. The method has been tried on 10 edentoulous patients, and is well tolerated by the patients. The error of the method has been calculated and the coefficient of variation was between 2.2 and 2.4. It is concluded that the method is suitable for obtaining a reproducible arbitrary estimation of the mineral content in the mandible, and for calculation of changes in the mineral content of the edentoulous mandibles. (auth)

33574 (AE-489(Vol. 2), pp 18-39) PERFORMANCE OF A DICHROMATIC AND SIMULTANEOUSLY OPERATING GAMMA-RAY ABSORPTIOMETER. Dissing, E. (Aktiebolaget Atomenergi, Studsvik, Sweden). Dec 1974.

From symposium on bone mineral determinations; Stockholm, Sweden (27 May 1974).

In bone mineral determinations.

The dichromatic technique of photon transmission scanning for measurements of bone mineral content in vivo was examined from the point of view of statistical and geometrical errors. Tabulations of figures of merit for combinations of energies E_1 and E_2 have been worked out for different tissue compositions. The single energy method using a water vessel with parallel walls was compared with the dichromatic method, particularly in view of the influence of adipose tissue. Further, information is given about the application of the method using the isotopes ^{125}I and ^{57}Co as γ sources. (auth)

33575 (AE-489(Vol. 2), pp 40-52) PROGRESS IN DUAL PHOTON ABSORPTIOMETRY OF BONE. Mazess, R. B.; Hanson, J.; Kan, W.; Madsen, M.; Pelc, N.; Wilson, C. R.; Witt, R. (Univ. of Wisconsin Hospital, Madison). Dec 1974.

From symposium on bone mineral determinations; Stockholm, Sweden (27 May 1974).

In bone mineral determinations.

Dual photon absorptiometry has not been as extensively investigated and utilized as has single photon absorptiometry for measurement of bone mineral content. For several applications dual photon absorptiometry is not only useful but essential. We have investigated the errors of precision and accuracy associated with both single and dual photon methods. A relative error function has been calculated for different radionuclides and their combinations to illustrate the variation to be expected at different bone and soft tissue thicknesses as a result of counting statistics. This permits choice of optimum sources for a particular application. However, factors other than counting statistics, such as cost, availability, range of desired applications, and desire for accuracy, are more important in the choice of which method and which source to use. The errors associated with the fat content of soft tissue, and the distribution of fat, have been assessed. In some cases the dual photon approach eliminates or minimizes the inaccuracies found with the single photon method. We have also developed an instrument providing direct digital readout of bone mineral content using the dual photon approach; this may decrease some of the technical problems involved in clinical application of the dual photon method. Finally the dual photon method has been used for scanning of spinal bone mineral with a 153-Gd source. These measurements have fairly high precision and accuracy (1 to 3% error) and can be used to look at the problem of localized spinal demineralization in osteoporosis. The method is also being developed for scanning of the femoral neck and total body mineral. (auth)

33576 (AE-489(Vol. 2), pp 53-66) DUAL PHOTON ABSORPTIOMETRY IN LUMBAR VERTEBRAE: PRECISION AND REPRODUCIBILITY. Roos, B. O.; Skoeldborn, H. (Sahlgrenska Sjukhuset, Goeteborg). Dec 1974.

From symposium on bone mineral determinations; Stockholm, Sweden (27 May 1974).

In bone mineral determinations.

The method considered here for measuring bone mineral is characterized by the following: Two photon energies (60 keV and 660 keV) are simultaneously detected by a NaI(Tl) detector. Stationary transmission measurements are made in a series of points transversally across the patient (usually above the third lumbar vertebra). The bone mineral (in g/cm^2) is calculated for each measuring point and plotted to give a bone profile curve. Integration above a manually determined base line gives an area A which is proportional to the sectional bone mineral content (in g/cm). Compared to an x-ray film a scintillation crystal can only be exposed to a relatively low photon flux in order to limit the dead time losses. On account of this, variations in the Poisson distributed count numbers can influence considerably on the precision. The total precision of a measurement includes (a) variations depending on Poisson statistics, and (b) object variations (e.g., set-up variations and patient movements during the measurement). The total precision has been estimated on statistical analyses of 10 assays on four normal adults, and calculating the standard deviation of the results for each individual. The coefficient of variation varied in the range of 3.4 to 5.7%. In another approach the coefficient of variation can be mathematically deduced, starting from Poisson distributed count numbers. Applied to the same data this theoretical coefficient of variation varied in the range of 3.5 to 4.8%. The result indicates that the object variations are relatively small and that the precision of the method is mainly determined by counting statistics. The long term stability has been determined by assays on aluminum standards. One standard assay was determined in June 1972 and in January 1974, 10 times on each occasion. The two means differed by 2.2% of the overall mean ±2.9% of the overall mean (95% confidence level). (auth)

33577 (AE-489(Vol. 2), pp 67-73) SCANNING DENSITOMETRY IN CATTLE. Zetterholm, R. (Veterinaerhoegskolan, Stockholm). Dec 1974.

From symposium on bone mineral determinations; Stockholm, Sweden (27 May 1974).

In bone mineral determinations.

Mineral metabolism is of great clinical interest in cattle. There are several conditions with disturbances in the calcium metabolism like e.g., hypocalcemia at parturition, bone and joint lesions in growing animals on intensive feeding, and hyperostosis and osteopetrosis in the adult or old animals. It is essential for the study of mineral metabolism in cattle that changes in bone density (calcium content) can be demonstrated. Photon transmission scanning was used to determine the calcium content of coccygeal vertebrae. The following technique was applied. The tail was anesthetized by epidural anesthesia and was well fixed to the scanner. Two vertebrae were scanned in toto. By scanning the same vertebrae at intervals of 2 to 5 weeks, a number of interesting data were obtained. Several examples can be given. A cow which was not given the usual amount of calcium in the feed during lactation lost about 25% of the calcium in 2 vertebrae during 4 months. Scanning revealed that bone density was restored when the cow was given the normal amount of calcium. Twenty-five cows predisposed for parturient paresis (hypocalcemia) were scanned at intervals during a period of 12 weeks before and after parturition. These cows were split in 2 groups, one which received a normal amount of calcium (75 g daily) and one which had a low calcium intake (40 g). With one exception, the clinical signs of paresis caused by hypocalcemia occurred during the calcium appositional phase. The animals which had a low calcium intake had a higher incidence of hypocalcemia and parturient paresis. (auth)

33578 (AE-489(Vol. 2), pp 74-87) SPECIAL APPLICATION OF A TRANSMISSION SCANNER FOR BONE MINERAL DETERMINATION IN NORMAL AND OSTEOPOROTIC RATS. Banzer, D.; Schneider, U.; Kraft, D. (Freie Univ., Berlin). Dec 1974.

From symposium on bone mineral determinations; Stockholm, Sweden (27 May 1974).

In bone mineral determinations.

For the quantitative determination of bone mineral content by photon transmission scanning in small animals, an adequate lucite box was constructed to contain the animals, scan rate was slowed down, and a special computer handling program was developed for calculation of mineral content given in arbitrary computer units. As in humans, a turnable x-ray tube allows the determination of

bone dimensions. By this means a good reproducibility of the measuring site in follow-up studies is ensured as well as calculation of bone mineral content in relation to bone width and thickness. The device was tested in practice on a group of fifteen adult Wistar rats in which osteoporosis was induced by feeding a calcium-free diet for four weeks. A normally fed control group was also measured. The midshaft of the femur, the proximal tibia and the center of a tail vertebra were immersed in water and scans were performed. In a first analysis of the data obtained we found significant differences of the absorptiometrically determined bone density between both groups in all measured sites. The rats with osteoporosis showed an average demineralization of 64% in the femur, 72% in the tibia, and 82% in the vertebra. (auth)

33579 (AE-489(Vol.2), pp 101-111) REPEATED BONE MINERAL MEASUREMENTS IN PATIENTS WITH PRIMARY AND SECONDARY HYPERPARATHYROIDISM BY PHOTON ABSORPTIOMETRY. Ringe, J. D.; Kruse, H. P.; Kuhlencordt, F. (Univ., Hamburg). Dec 1974.

From symposium on bone mineral determinations; Stockholm, Sweden (27 May 1974).

In bone mineral determinations.

Bone mineral measurements of the radius were realized by ^{125}I-photon-absorptiometric scanning on 11 patients with primary hyperparathyroidism and 34 patients with secondary hyperparathyroidism. In primary hyperparathyroidism the bone mineral loss was on an average of 24.8%. The bone mineral content of some of those patients was also controlled postoperatively. On 14 patients with secondary hyperparathyroidism caused by chronic renal failure we obtained greatly differing values for the individuals, i.e., from +8.7 to 37.3% of the normal mineral content. On a further 20 patients with secondary hyperparathyroidism on maintenance hemodialysis 64 scans were made in a period of 13 months. The values ranged from normal to very low, but the individual patients did not show any significant tendency to gain or to lose bone mineral in the course of observation. (auth)

33580 (AE-489(Vol. 2), pp 112-121) REPEATED MEASUREMENTS OF BONE MINERAL CONTENT BY PHOTON ABSORPTIOMETRY IN VERTEBRAL COLLAPSE PATIENTS AND NORMAL CONTROLS. A One Year Follow-up Study. Dequeker, J.; Creytens, G.; Gielen, F. (Academic Hospital Pellenberg, Belg.). Dec 1974.

From symposium on bone mineral determinations; Stockholm, Sweden (27 May 1974).

In bone mineral determinations.

In 19 patients suffering from vertebral collapse and in 57 normal controls bone mineral content was measured twice with an interval of one year. Bone mineral content was estimated using photon transmission scanning. The photon beam source was ^{125}I. The sites measured were the left second metacarpal at midpoint and the radius at 3 cm and 8 cm from the distal end. The ends of the metacarpal and the radius were found by palpation and the measuring sites marked. The measuring sites were covered with an uniform soft tissue cover. For each subject the follow-up measurements were calculated as percent of the start value, which was designated as 100 percent. No significant change in bone mineral content after one year could be found in the control group. There was also no significant difference in % change after one year between pre- and postmenopausal women or between men and women. The patients suffering from vertebral collapse as a group differed significantly from the control group. (auth)

33581 (AE-489(Vol. 2), pp 123-130) ABSOLUTE CALIBRATIONS OF A ^{125}I BONE ABSORPTIOMETRY SYSTEM. Zimmerman, R. E.; Griffiths, H. J.; Pletka, P.; Bernstein, D. (Harvard Univ., Boston). Dec 1974.

From symposium on bone mineral determinations; Stockholm, Sweden (27 May 1974).

In bone mineral determinations.

In photon absorptiometric measurements of bone mineral content it is essential to know the absolute calibration of the experimental apparatus. A calibration procedure has been performed using a human ulna that was fixed in position, and scanned at the center of each of 14 intervals. An index of bone mineral content (BMU) for each segment of bone was thus obtained. The coefficient of variation for these measurements was 1.5 to 3%. The bone was then cut into 14 segments, dried and weighed. The bone was ashed and the residue weighed. The ash was dissolved in HCl and the calcium content was determined. The calibration equations and correlation coefficients are presented and discussed. (auth)

33582 (AE-489(Vol. 2), pp 131-147) SYSTEMATIC ERRORS IN DETERMINATION OF BONE MINERAL CONTENT IN VIVO. Rassow, J. (Univ., Essen). Dec 1974.

From symposium on bone mineral determinations; Stockholm, Sweden (27 May 1974).

In bone mineral determinations.

For the repeated checking of bone mineral content of a patient by photon transmission scanning without changing the measuring symmetry, the unsystematic errors are of importance for the quality of the measured quantity. Further, systematic errors are additionally significant when comparing different subjects and establishing normative data. The basic problems for the densitometric measurements are discussed as well as the different methods and the approximate assumptions utilized. An analysis of the numerous methods described in the literature and the used mathematical models results. Recommendations are presented to avoid systematic errors and to attain not only a good reproducibility of possible errors but also a high accuracy. (auth)

33583 (AE-489(Vol. 2), pp 148-166) PHOTON ENERGY, BEAM DIAMETER, AND SCAN VELOCITY EFFECTS IN THE MEASUREMENT OF LINEAR BONE MINERAL MASS BY PHOTON ATTENUATION. Watt, D. E. (Univ., Dundee, Scotland). Dec 1974.

From symposium on bone mineral determinations; Stockholm, Sweden (27 May 1974).

In bone mineral determinations.

A fundamental theoretical study was made of the gamma ray attenuation technique for measuring linear bone mineral mass. Calculation of errors arising solely from statistical fluctuations in photon counting permit selection of the optimum photon energy for maximum precision. Comparison of the statistical results shows that the single beam method is always inherently more precise than the double beam method. Errors due to finite collimator size and to beam scanning velocity are determined for intermittent and continuous scanning. In particular the finite beam size gives rise to two errors. The first is due to the purely geometric overlap of the beam at the transition regions around bone edges and the other concerns the fact that the observed bone thickness at any point in the scan is averaged over the collimator width. For continuous scanning there is an additional error component due to the distance travelled between observations. It is found that for small bones the absolute error may be very large but can be reduced to within reasonable bounds by appropriate selection of the collimator diameter and scanning velocity. (auth)

33584 (AE-489(Vol. 2), pp 167-171) STANDARDIZATION PROBLEMS IN THE DOUBLE ISOTOPE METHOD USING THE STUDSVIK BONE SCANNER 7102. van der Veen, E. A.; Netelenbos, J. C. (Vrije Univ., Amsterdam). Dec 1974.

From symposium on bone mineral determinations; Stockholm, Sweden (27 May 1974).

In bone mineral determinations.

Bone mineral content measuring, using photon transmission scanning and the double isotope sources gave initially irreproducible and incomparable results due to several causes. An aluminum standard proved to be useful for standardization procedures. Three comparable aluminum cylinders of different mass were measured after at random standardization of the Bone Scanner. A linear relationship appeared to exist in mass measuring by the scanner compared to the actual mass of the cylinders. A similar relationship although not completely parallel was found after at random standardization. Correction of measurements by a normogram seems possible, at least within certain limits. Reproducibility was tested in 6 patients at two different localized areas. Comparable results were obtained with a margin of difference of about 5%. For practical clinical use the double isotope method proved not to be useful as far as small changes in the mineral content are concerned. (auth)

33585 (AE-489(Vol. 2), pp 172-181) METHOD TO ESTIMATE THE ERROR CAUSED BY ADIPOSE TISSUE IN BONE ABSORPTIOMETRY. Judy, P. F.; Vogel, J. M. (Harvard Univ., Boston). Dec 1974.

From symposium on bone mineral determinations; Stockholm, Sweden (27 May 1974).

In bone mineral determinations.

Variation in the amount of adipose tissue has been reported to cause a significant error in the measurement of bone mineral mass by photon transmission scanning. A method has been developed to estimate the magnitude of that error. The bone mineral mass of a site was measured absorptiometrically using ^{125}I (28 keV) and ^{153}Gd (44 keV or 100 keV) γ sources. A linear regression of measurement of bone mineral mass at each photon energy and an experimentally determined factor, K, which related linearly the adipose defect to the magnitude of the error in bone mineral measurement was performed. The adipose defect was defined to be the integral of difference of the mass of adipose tissue in the photon beam during the measurement of the baseline transmission and the transmission through the bone integrated along the scan path. The slope of the regression was the estimate of the adipose defect, while the intercept provided

an accurate estimate of bone mineral mass. The factor, K, was determined in the following manner. Polymethyl-methacylate tubes were filled with soybean oil to simulate adipose tissue. The tubes were placed over a bone mineral reference standard which was developed at the Bone Mineral Laboratory of the University of Wisconsin. The standard and the simulated adipose defect were placed in a water bath and scanned with each source. The scans were repeated with the tubes filled with water. The difference between the two measurements of bone mineral mass was the error caused by the adipose defect. The method was applied to the rectilinear scan of the os calcius using ^{125}I. The error was estimated on three occasions in six subjects during a bedrest study. The mean error was 1.3 ± 0.5% (SD), when the baseline was estimated from the minimum transmission through the soft tissue alone over a 3-mm interval at the edge of the bone. The mean error was 6 ± 0.5%, when the transmission at both edges of the bone was used to estimate the baseline. No significant variation in the error was observed between individuals or in any single individual during the study. The results indicate that this method for estimating the error caused by variation in the composition of soft tissue is useful in serial studies. The method is not recommended to correct the error of an individual measurement because it will reduce the precision of the measurement of bone mineral mass. (auth)

33586 (BNL-50418, pp 379-398) RADIOLABELED ANTIBODIES: THEIR POTENTIAL AS QUANTITATIVE TOOLS FOR IN VITRO AND IN VIVO TUMOR DIAGNOSIS. Weissman, I. L.; Nord, S.: Ellis, R. (Stanford Univ., CA). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

Studies were conducted on the specificity and mode of binding of a highly purified radioiodinated pooled rat antibody to Moloney tumor antigens as expressed by binding to a murine Moloney lymphoma, LSTRA. Methods are described for evaluating the specificity of binding of ^{125}I, ^{127}I, and ^{131}I-labeled antibody to antigenic target cells. It was concluded that radiolabeled anti-Moloney antibodies were useful for basic tumor immunology and the study of model systems of antigenic human tumors. (HLW)

33587 DETERMINATION OF DIFFERENTIAL RENAL FUNCTION BY SEQUENTIAL RENAL SCINTIGRAPHY. Hayes, M.; Brosman, S.; Taplin, G. V. (Univ. of California, Los Angeles). J. Urol.; 111: 556-559(May 1974).

A simple and accurate method of determining split renal function (tubular excretion) using sequential renal scintigraphy has been developed based on quantitation of 3 areas of interest (left kidney, right kidney and pelvic background) during the 1 to 2-minute post-injection period of ^{131}I hippurate. The percentage of total renal function for each kidney determined in this manner correlates well (r = 0.974) with the standard constant infusion hippurate clearance using individual renal urine collection techniques. This high correlation between the 2 techniques indicates the feasibility of the non-invasive isotope procedure as a method for determining an index of divided renal function. The only equipment needed is a widely available scintillation camera with area of interest capabilities and the results are immediately obtainable at the conclusion of a standard 20-minute sequential renal scan. A simple ratio without need for complicated mathematical analysis or use of computers is used to determine the percentage of function each kidney is contributing toward the total. The scan method which carries negligible discomfort and risk may be used with confidence in place of the more cumbersome standard techniques requiring ureteral catheterization. In addition to its accuracy, theoretical simplicity, technical ease and lack of patient morbidity, this scintigraphic method of measuring divided renal function is unaffected by degrees of urinary tract obstruction which would make results with the standard clearance methods grossly inaccurate. (auth)

33588 COMPARISON OF RADIOAEROSOL WITH RADIOXENON INHALATION PROCEDURES IN OBSTRUCTIVE LUNG DISEASE AND PULMONARY EMBOLISM. Taplin, G. V.; Poe, N. D.; Isawa, T.; Dore, E. K. Contract AT(04-1)-gen-12. pp 193-208 of Clinical Dynamic Function Studies With Radionuclides. Croll, M. N.; Brady, L. W.; Tatem, H. R. III; Honda, T. New York; Meredith Corp. (1972).

A normal perfusion ^{133}Xe scan excludes clinically significant pulmonary embolism and precludes the need for angiography. Scans showing loss of perfusion to an entire lung, a lobe, or a segment, together with a negative chest film, provide strong evidence for pulmonary embolism—angiography is nearly always confirmative but now seldom used. A normal aerosol (^{99m}Tc) scan rules out chronic and acute obstructive airway disease with equal or greater reliability than a normal perfusion scan which excludes significant arterial occlusive disease. Perfusion and aerosol inhalation lung imaging should be performed in rapid sequence whenever underlying obstructive airway disease is suspected, because in such patients positive perfusion scans have much less diagnostic significance. The data from both perfusion and aerosol inhalation lung imaging permit an accurate diagnosis and appropriate treatment in all but the most complicated cases within one to two hours or less. Embolectomy is now rarely indicated. (auth)

33589 RADIOIMMUNOASSAY FOR INSULIN. Coffey, J. W.; Hansen, H. J. (to Hoffmann-La Roche Inc.). US Patent 3,867,518. 18 Feb 1975. Filed date 9 Mar 1973. 6p.

A rapid radioimmunoassay for detecting immunoreactive insulin in body fluids, e.g., blood plasma, utilizing zirconyl phosphate gel at a pH at which free insulin will not bind to it, i.e., pH of 6.0 to 6.5, preferably 6.25, to adsorb antibody-bound insulin while leaving free insulin in solution, is disclosed. (Official Gazette)

33590 PARTICULATE NATURE OF O-DIPHENOLOXIDASE IN MYCOBACTERIUM LEPRAE AND ASSAY OF THE ENZYME BY THE RADIOISOTOPE TECHNIQUE. Prabhakaran, K.; Harris, E. B.; Kirchheimer, W. F. (Public Health Service Hospital, Carville, LA). Microbios; 8: 151-157(1973).

The o-diphenoloxidase (E.C. 1.10.3.1) of Mycobacterium leprae was found to be firmly attached to structural elements in the bacterial cell, unlike plant tyrosinase which is soluble. The phenoloxidase of Tenebrio molitor (meal worm) and Fasciola hepatica (liver fluke) was also bound to the particulate fraction. M. leprae was disrupted by ultrasonic oscillation. Treatment of the disrupted bacteria with sodium dodecyl sulphate released the o-diphenoloxidase of the organisms into the supernatant. A "microsomal" fraction prepared from Harding-Passey mouse melanoma was rich in tyrosinase. Deoxycholate-treatment was the most effective procedure for liberating the mammalian tyrosinase from the particles. For the first time, the radioisotope technique was employed in the assay of the o-diphenoloxidase of M. leprae, obtained from human leprous tissues as well as from tissues of experimentally infected armadillos. The method being highly sensitive, the metabolic activities of the leprosy bacilli (which are available only in limited quantities) can be studied by using small amounts of the organisms. (auth)

33591 ^{18}F SCINTIGRAPHY OF NON-NEOPLASTIC SKELETAL LESIONS. A Preliminary Report. McGrail, J. W.; Vulpetti, A. T.; Shifrin, L. Z. (Henry Ford Hospital, Detroit). Clin. Orthop.; No. 101, 292-298(Jun 1974).

Fluorine-18 is well suited for studying skeletal diseases. Because this radionuclide has a short half-life, low radiation dosage, excellent uptake by bone, and rapid urinary excretion, it has considerable potential application in Orthopedics. Uptake patterns indicate that most displaced femoral neck fractures are associated with a significant degree of avascularity which improves within 6 to 8 weeks after injury. Undisplaced fractures seem to maintain their vascular integrity. Non-traumatic aseptic necrosis of the femoral head has been characterized by increased uptake presumably secondary to reparative changes. Infections of bone and joint demonstrated increased uptake before radiographic signs allowing earlier localization and confirmation of the diagnosis. Of greater usefulness in clinical interpretation of ^{18}F scans is that the technique seems to effect bone perfusion independent of histologic bone formation. (auth)

33592 DETECTION OF ANTI-GLOMERULAR BASEMENT MEMBRANE ANTIBODIES BY A RADIOIMMUNOLOGICAL TECHNIQUE. Mahieu, P.; Lambert, P. H.; Miescher, P. A. (University Hospital, Geneva). J. Clin. Invest.; 54: 128-137(Jul 1974).

A radioimmunoassay for detection of anti-glomerular basement membrane (GBM) antibody was set up with a 70,000 mol wt GBM antigen, labeled with ^{125}I and containing both types of oligosaccharidic chains present in the whole membrane. Separation of free radioactive antigens from antigens bound to immunoglobulins was obtained by precipitation with polyethylene glycol (mol wt, 6,000), at a final concentration of 20%. In the presence of normal human or rabbit sera, less than 20% of labeled antigens were precipitated. In the presence of rabbit anti-human GBM antibodies, up to 82% of GBM antigens were precipitated, while in the presence of sera or of kidney eluate from a patient with Goodpasture's syndrome, the precipitation of GBM antigens reached 43%. The avidity of rabbit anti-GBM antibodies for human GBM antigens is higher than that of human anti-GBM antibodies. In the case of Goodpasture's syndrome, the binding of anti-GBM antibodies to labeled antigens was inhibited more efficiently by the disaccharide-containing glycopeptide than by the heteropolysaccharide-containing glycopeptide purified from

whole GBM. Anti-GBM antibodies were searched for in the serum of 300 normal blood donors, of 120 patients with glomerulonephritis (GN) and granular deposits, and of 14 patients with GN and linear deposits of immunoglobulins. After correction for the nonspecific precipitation, the average percentage (±1 SD) of labeled antigens precipitated in the serum of normal blood donors was 0.3 ± 3.2%; 12 patients with GN and linear deposits exhibited high circulating anti-GBM antibody titers, while 8% of the patients with GN and granular deposits presented significant, albeit lower, anti-GBM activity in their sera. (auth)

33593 RADIOISOTOPIC ASSESSMENT OF MYOCARDIAL INFARCTION. Meyers, R. W.; Goldstein, R. E. (National Heart and Lung Inst., Bethesda, MD). New Engl. J. Med.; 291: No. 4, 203-205(25 Jul 1974).

Infarct scintiscanning offers a potentially important means of assessing the location and extent of myocardial infarction in man. Holman et al. have presented promising preliminary data indicating that ^{99m}Tc-tetracycline yields positive scans in patients with acute myocardial infarction. Further experience is necessary, however, to determine the strengths and limitations of this scanning technic. (auth)

33594 HUMAN THYROXINE-BINDING GLOBULIN (TBG) SOLID PHASE RADIOASSAY. Castro, A.; Ugarte, E. (United Medical Labs., Miami, FL). Res. Commun. Chem. Pathol. Pharmacol.; 7: No. 2, 453-458(Feb 1974).

A solid phase radioassay for measurement of circulating thyroxine-binding globulin (TBG) in body fluids is reported. The TBG was attached to diazotized arylamine glass and reacted with labelled and unlabelled TBG for saturation analysis. The assay is accurate, rapid and sensitive. (auth)

33595 IODINE METABOLISM IN LEUKOCYTES: EFFECT OF GRADED IODIDE CONCENTRATIONS. Stolc, V. (Univ. of Pittsburgh). Biochem. Med.; 10: No. 3, 293-299(Jul 1974).

Increasing concentrations of iodide in the medium produce a rise in the ^{127}I newly bound to iodocompounds in the resting and phagocytosing human leukocytes. Organic iodine rises in resting leukocytes as the iodide concentration in the medium is increased from 0.001 to 10 mg iodide/100 ml. There is no additional increase in organic iodine in phagocytosing leukocytes between 0.1 and 10 mg iodide/100 ml; however, the organic iodine is not significantly lowered at the highest iodide concentration in the media. These data prove that the Wolff-Chaikoff phenomenon is not demonstrable in human leukocytes. (auth)

33596 PLASMA CORTISOL DETERMINATION: RADIOIMMUNOASSAY AND COMPETITIVE PROTEIN BINDING COMPARED. Farmer, R. W.; Pierce, C. E. (Texas Medical Center, Houston). Clin. Chem.; 20: No. 4, 411-414(1974).

A simple radioligand assay was developed for measuring cortisol in plasma and urine. The antiserum was produced in rabbits by using cortisol-21-hemisuccinyl-bovine serum albumin as the antigen. The standard curve was linear from 0 to 1000 pg. A small aliquot of ethanol-precipitated plasma or urine is directly assayed. Interassay variability of 56 separate assays of a normal plasma pool during six months was: mean, 224 μg/liter; range, 210-238 μg/liter; CV, 3.2%. In assay of multiple samples obtained between 0800 and 1800 hours from normal young men, radioimmunoassay (RIA) gave consistently lower values than did competitive protein binding (CPB). The relationship, as calculated from results for 41 single samples, is expressed by the equation RIA = 0.713 CPB + 0.59, suggesting that the normal range for RIA should be 35 to 180 μg/liter rather than the 50 to 250 μg/liter usually cited. Although there is crossreactivity with 11-deoxycortisol, this assay is clearly superior to CPB: it is more specific, has a wider range (<8 to 400 μg/liter), and requires less technician time. (auth)

33597 RADIOIMMUNOASSAY OF THE NEUROLEPTIC DRUG PIMOZIDE. Michiels, L. J. M.; Heykants, J. J. P.; Knaepe, A. G.; Janssen, P. A. J. (Janssen Pharmaceutica, Beerse, Belgium). Life Sci.; 16: No. 6, 937-944(15 Mar 1975).

Pimozide was made antigenic by coupling it to bovine serum albumin. This pimozide-protein conjugate induced antibodies against pimozide in rabbits. By using the antiserum, the drug could be detected in amounts as low as 50 picogram. The binding capacity of the antibodies was high for pimozide and for the closely related neuroleptic analogues clopimozide, fluspirilene, and penfluridol. Therefore, the diphenylbutylamine-moiety of the pimozide molecule was required for strong binding. No cross-reaction was observed with the major metabolites of pimozide, even at 500 times higher concentration, so they will not interfere with a radioimmunologic determination of pimozide in human plasma. (auth)

33598 OPTIMAL STATISTICAL DESIGN OF RADIOIMMUNOASSAYS AND COMPETITIVE PROTEIN-BINDING ASSAYS. Chang, P. C.; Rubin, R. T.; Yu, M. (Univ. of California, Los Angeles). Endocrinology; 96: No. 4, 973-981(Apr 1975).

The statistical analysis of radioimmunoassay and competitive protein binding assay data is complex. Because the response variable (percent counts) is not linearly related to log dose, a logit transformation of the response variable usually is performed to permit linear regression analysis. This transformation induces marked heterogeneity of variance, so that iterative weighted regression programs have been used to achieve the best standard curve and the most precise dose estimates of unknowns. In this study several parameters of assay design are investigated in order to establish those designs yielding antigen concentration estimates of highest precision as well as estimates of comparable precision by either simple linear regression analysis or by the more complex weighted regression technique. Unknown estimates of highest precision are obtained when (1) the percent counts of the standard doses cover a range of approximately 80% to 20%, (2) the number of standard dose levels is eight or more, (3) the number of replicates at each dose level is two or more, and (4) the percent counts of the unknowns also are within the range 80% to 20%. Under these conditions, also, simple linear regression yields unknown estimates of comparable precision to weighted regression and therefore may be safely used. (auth)

33599 SINGLE IMAGE PERICARDIAL EFFUSION EVALUATION WITH TECHNETIUM COMPOUNDS. Cook, C. B. (Fairfax Hospital, Falls Church, VA); Dunson, G.; McFarland, P.; Godwin, I. D. S. Med. J.; 68: No. 4, 392-394(Apr 1975).

Three cases of suspected pericardial effusion were evaluated with rapid, noninvasive procedure, combined use of macroaggregated albumin technetium-99m and human serum albumin technetium-99m to produce a single radiograph showing the heart, liver, and lung perfusion simultaneously. This technic confirmed the diagnosis of pericardial effusion in two cases and ruled out this possibility in the third case. (auth)

33600 DIRECT RADIOIMMUNOASSAY FOR ANTIGENS AND THEIR ANTIBODIES. Ling, C. M. (to Abbott Labs.). US Patent 3,867,517. 18 Feb 1975. Filed date 21 Dec 1971. 6p.

A method for direct radioimmunoassay of antigens or their associated antibodies utilizing a coated test well comprising adding a serum to be tested for an antigen to test apparatus coated with its antibody; incubating the tubes for from 0.5 to 42 hours; aspirating the contents and washing the same with a Tris-HCl and sodium azide mixture; adding purified I-125-labeled antibody into the tube and incubating for from 1 to 24 hours; aspirating and washing the contents; and counting the tube for I-125 radiation. A similar assay for the antibody may be conducted utilizing an antigen coated tube and I-125 labeled antigen. The method for coating these tubes comprises adding the antigen or antibody solution in a Tris-HCl, sodium azide solution into a suitable test tube or well, incubating the tubes at room temperature from 6 to 72 hours, aspirating and washing the contents and storing at from between 2 and 25°C until use. (Official Gazette)

33601 EVALUATION OF ALTERNATIVE COUNTING METHODS FOR RADIOIMMUNOASSAY OF HEPATITIS-ASSOCIATED ANTIGEN (HB Ag). Jordan, W. C. (Intercommunity Presbyterian Hospital, Whittier, CA); Spiehler, V.; Haendiges, R.; Helman, E. Z. Clin. Chem.; 20: No. 7, 733-737(1974).

Alternative counting methods for the Abbott Aus-RIA hepatitis-associated antigen test were devised and evaluated. These methods involve solubilization of the tube-bound radiolabeled complex with glacial acetic acid, transfer of the eluate to a counting vial of choice, and measurement by either a gamma scintillation or a liquid scintillation system. These methods, when compared to the direct counting of the AusRIA tube for sera from more than 250 patients and controls, gave a correlation coefficient of 0.94 to 0.99. Iodine-125 counting efficiences averaged 65% both for direct counting of the AusRIA tube and for gamma counting of the eluate. By liquid scintillation counting, iodine-125 counting efficiency averaged 50%. This method avoids high background, chemiluminescence, and quench, and is easy to perform. By using glacial acetic acid to solubilize the labeled material, the eluate can be counted by various types of gamma counters as well as by liquid scintillation systems. (auth)

33602 RADIOIMMUNOASSAY OF PLASMA OESTRIOL. Youssefnejadian, E.; Sommerville, I. F. (Chelsea Hospital for Women, London). J. Steroid Biochem.; 4: No. 6, 659-664(Nov 1973).

A relatively specific antiserum to oestriol-16-17-dihemisuccinate-bovine serum albumin was raised in white New Zealand rabbits and a radioimmunological method developed for the quantitative determination of ether-extractable oestriol in the peripheral venous plasma (0.1 ml) of pregnant women. The method

has been evaluated and applied to the determination of plasma oestriol in 400 blood samples collected from women with uncomplicated pregnancies. (auth)

33603 RADIOIMMUNOLOGICAL DETERMINATION OF PLASMA ESTRADIOL-17β USING PRECIPITATION OF THE PLASMA GLOBULIN FRACTION. Onikki, S.; Adlercreutz, H. (Univ., Helsinki). J. Steroid Biochem.; 4: 633-639(Nov 1973).

A practical and specific radioimmunological method for the determination of human plasma estradiol is described. The procedure involves partial purification of the steroid with ammonium sulfate precipitation of sex hormone binding globulin (SHBG). A specific antiserum against 11α-hydroxyestradiol-11-succinyl-bovine serum albumin is used in the final assay. The method was shown to fulfill the reliability criteria. (auth)

33604 VALIDATION OF THE DUAL-ISOTOPE PLASMA RATIO TECHNIQUE AS A MEASURE OF CHOLESTEROL ABSORPTION IN OLD AND NEW WORLD MONKEYS. Corey, J. E.; Hayes, K. C. (Harvard School of Public Health, Boston). Proc. Soc. Exp. Biol. Med.; 148: No. 3, 842-846(Mar 1975).

Due to the experimental importance of being able to assess cholesterol absorption during the study of atherogenesis in primates, the plasma isotope ratio technique developed for rats by Zilversmit was tested in New and Old World monkeys and compared with a more cumbersome procedure involving fecal collection and analysis. Although fecal analysis demonstrated an unaccountable loss of the intubated isotope, the comparability of the plasma ratios to absorption calculated by other methods suggests that this technique is probably as reliable as many presently available. The loss of isotope may reflect the absence of dietary cholesterol. (auth)

33605 BRONCHIAL MUCUS AFTER LUNG AUTOTRANSPLANTATION IN DOGS. Morinari, H.; Shimada, K.; Taplin, G. V.; Johnson, D. E.; Benfield, J. R. (Harbor General Hospital, Torrance, CA). Contract AT(04-1)-gen 12. J. Indian Chem. Soc.; 67: No. 3, 484-490(Mar 1974).

Mucus transport in the bronchi of normal and autotransplanted dog lungs was studied with radioisotopic and radiographic methods. There is impaired mucus transport on the operated side in the early postoperative period. Recovery usually occurred within 1 month. Radiologic study of clearance of barium sulfate paste showed the same time course as the radioisotopic method. The exact mechanism(s) producing the impaired bronchial clearance remain unknown, but denervation seems unlikely to be the major pathogenetic factor because of the relatively rapid rate of recovery during the period of persistent denervation. (auth)

33606 CLINICAL EVALUATION OF INDIUM-111 BLEOMYCIN AS A TUMOR-IMAGING AGENT. Lilien, D. L.; Jones, S. E.; O'Mara, R. E.; Salmon, S. E.; Durie, B. G. M. (Univ. of Arizona, Tucson). Cancer; 35: No. 4, 1036-1049(Apr 1975).

In an evaluation of indium-111-bleomycin as a tumor-imaging agent, 357 whole-body tumor scans were performed in 293 patients. Of 246 studies performed in patients with a variety of active solid tumors, 218 (89%) were true-positive studies and 28 (11%) were false-negative. Of 69 scans in patients thought to be free of tumor after therapy, 32 (46%) were false-positive studies and 37 (54%) were true-negative. The true-positive rates by major tumor type were: adenocarcinoma of gastrointestinal tract origin (95%), lymphoma (88%), melanoma (87%), sarcomas (82%), lung (77%), breast (77%), childhood tumors (71%), gynecologic tumors (70%), and genitourinary tumors (68%). Soft tissue and lymphatic sites of tumor, both above and below the diaphragm, were easily visualized, whereas hepatic and bone marrow sites of involvement were less easily discerned. False-positive uptake with ^{111}In-bleomycin was noted in lungs (6%), gut (3%), mediastinum (2%), normal breast tissue (0.8%), and in occasional inflammatory lesions. In 19 patients with multiple myeloma or leukemia, a pattern of diminished bone marrow uptake associated with abnormal accumulation of ^{111}In-bleomycin in extramedullary sites of involvement was the rule. In another 23 patients in whom scans were performed because an occult tumor was suspected, scanning did not lead to specific diagnosis of tumor in a single instance. We conclude that ^{111}In-bleomycin is a safe, effective, and useful new tumor-imaging agent in the initial staging and followup of patients with a variety of solid tumors. Significant advantages of this agent over other currently available radiopharmaceuticals include: a broader spectrum of tumors taking up the radio-pharmaceutical; and generally better delineation of abdominal and pelvic disease due to lack of interference from gut uptake. (auth)

33607 SIMPLE RADIOIMMUNOASSAY FOR 3',5', CYCLIC ADENOSINE MONOPHOSPHATE. Farmer, R. W.; Harrington, C. A.; Brown, D. H. (Univ. of Texas, Houston). Anal. Biochem.; 64: No. 2, 455-460(Apr 1975).

A radioimmunoassay for 3',5' cAMP has been developed in which [^{3}H]3',5' cAMP is the radioligand. Antibody-bound and free fractions are separated with dextran-coated charcoal. The sensitivity of the assay is 0.03 pmoles and antiserum specificity is seven orders with respect to other adenine nucleotides. Samples are prepared by ethanol precipitation. Tissue levels of 3',5' cAMP are comparable to those reported by others. (auth)

33608 MICRO-RADIOIMMUNOASSAY FOR ANTIBODIES TO NEWCASTLE DISEASE VIRUS IN THE CHICKEN. Cleland, G. B.; Perey, Y. Y. E.; Dent, P. B. (McMaster Univ., Hamilton, Ont.). J. Immunol.; 114: No. 1, 422-425(Jan 1975).

An indirect micro-radioimmunoassay is described in which chicken anti-Newcastle disease virus antibody was detected, with radioactively labeled rabbit anti-chicken Fab, on virus-infected microcultures of chick embryo fibroblasts. Newcastle disease virus-infected microcultures were formalin fixed and stored at 4°C for up to 4 months without affecting the sensitivity of the test. The micro-technique was found to be a highly sensitive and specific assay of anti-viral antibody and may allow detection of immunoglobulin class of anti-Newcastle disease virus antibody. (auth)

33609 QUANTITATIVE DETERMINATION OF VITAMIN B_{12} IN BLOOD BY RADIOASSAY. Yonahara, Y.; Takahara, Y.; Kirimura, H.; Fukuiya, Y.; Kawato, M. (National Second Hospital of Tokyo (Japan)). Radioisotopes (Tokyo); 23: No. 1, 26-31(Jan 1974). (In Japanese).

Quantitative determination of vitamin B_{12} in blood by competitive binding analysis using a sephadex intrinsic factor complex as a binder was studied. A standard curve obtained by diluting a standard vitamin B_{12} dilution (1600 pg/ml) was slightly sigmoid in the range from 25 to 1600 pg/ml. When the same sample was analyzed in duplicate to check reproducibility, the variation coefficient was low, and the method was thought applicable to the clinical determination. Changes of vitamin B_{12} in blood by dilution of serum and recovery rates of vitamin B_{12} were studied. No fixed correlation between the observed values and the dilution rates was observed and mean recovery rate was 99.92%. The normal range of vitamin B_{12} in serum obtained with normal 50 subjects is 564.6 ± 261.3 (210 to 1200) pg/ml. After injecting 100 mg of tetrahydrofolate (FAH_4) intramuscularly to normal subjects and patients with megaloblastic anemia, aplastic anemia, nephrosis, and Banti's syndrome, changes of vitamin B_{12} in blood were studied. In patients with aplastic anemia, nephrosis, and Banti's syndrome, significantly low values were obtained 2 to 4 hours after injection. Though this method has to be studied further in some aspects, it is simple and many samples can be analyzed in a relatively short time. For this reason it is considered that the method would be widely applicable. (auth)

33610 FUNDAMENTAL APPRAISAL FOR THE MEASUREMENT OF PLASMA RENIN ACTIVITY AND ITS CLINICAL USE FOR THE DIAGNOSIS AND TREATMENT OF HYPERTENSION. Ohtake, M.; Onaya, T.; Yamada, T. (Shinshu Univ., Nagano (Japan). Faculty of Medicine). Radioisotopes (Tokyo); 23: No. 1, 32-37(Jan 1974). (In Japanese).

Blood was obtained from normal subjects, pregnant women, and hypertensive patients at rest, after walk, and during receiving diuretics, and plasma renin activity was measured by using radioimmunoassay kits supplied by two commercial sources. In order to get a reliable data, attempts were made to check the possible influences of dilution of plasma, error in making standard curve, variations of the data from kit to kit, error associated with the storage of the test materials, and the importance of constant incubation. In normal subjects, plasma renin activity (PRA) was low at rest and elevated after walk, but no diurenal variation was found. During pregnancy, PRA was apparently elevated but this high value subsided rapidly after delivery. The most of young patients with essential hypertension have normal or slightly high PRA, whereas older patients with essential hypertension have low normal or low PRA. Also, the patients with primary aldosteronism have low PRA. Administration of diuretics elevated PRA in patients with essential hypertension but failed to do so in primary aldosteronism. From the data accumulated, it is concluded that PRA is useful for differentiating several types of hypertension and for selecting the drugs for hypertension. (auth)

33611 INCORPORATION OF GLUCOSE-1-^{14}C INTO CHITIN OF THE EXOSKELETON OF A SHORE CRAB, WITH SPECIAL REFERENCE TO THE PERIOD OF ENDOCUTICLE FORMATION. Yano, I. (National Pearl Research Laboratory, Ago, Mie (Japan)). Nippon Suisan Gakkaishi; 40: No. 8, 783-787(Aug 1974). (In Japanese).

The incorporation of radioactivity into chitin of the exoskeleton after injection of glucose-1-^{14}C into the blood of a shore crab, Gaetice depressus, was studied in relation to chitin synthesis at stages of the molting cycle. The ratio of chitin to organic matter

was determined to be 67.9% in the completed exoskeleton, but different in each cuticle layer; that is, 22.4% in the exocuticle, 74.9% in the endocuticle, and 63.3% in the membranous layer. During the period of endocuticle formation, the radioactivity was rapidly incorporated into chitin within several hours after the injection of glucose-1-^{14}C, while that in blood decreased correspondingly. Throughout the molting cycle, the highest value of incorporation within 24 hours was shown at one day after molting suggesting that the most active synthesis of chitin occurs at the beginning of endocuticle formation and slows down thereafter with the lapse of time. (auth)

33612 PERFUSION LUNG SCANNING BY ^{99m}Tc-MAA. Isawa, T.; Shiraishi, K.; Matsuda, T.; Konno, J. (Tohoku Univ., Sendai (Japan). School of Medicine); Ohkubo, K. Nippon Kyobu Rinsho; 33: No. 7, 474-477(Jul 1974). (In Japanese).

Lung perfusion scanning was performed in 27 patients with various chest diseases by ^{99m}Tc-MAA, which was prepared at the laboratory using "Techne-MAA-Kit". Neither objective nor subjective untoward reactions were noted and lung function remained unaltered following intravenous injections of this radiopharmaceutical. There were no recognizable changes in lung perfusion images and perfusion partition ratios to the right and left lungs between ^{99m}Tc-MAA and simultaneously injected ^{131}I-MAA. The ^{99m}Tc-MAA was easy to prepare and stable after tagging; its radiochemical purity was over 98% and free or unbound $^{99m}TcO_4^-$ was less than 2% during 5 hours' observation after preparation. This radiopharmaceutical can be labeled the most ideal perfusion lung scanning agent so far available. (auth)

33613 CLINICAL EVALUATION OF THE XENON-133 WASHOUT TECHNIQUE IN UROLOGICAL PATIENTS. Kawamura, J.; Harada, T.; Sawanishi, K.; Ishii, Y.; Torizuka, K. (Kyoto Univ. (Japan). Faculty of Medicine). Hinyokika Kiyo; 20: No. 4, 219-232(Apr 1974). (In Japanese).

Renal blood flow was measured in 22 patients with a variety of renal abnormalities using the xenon-133 washout technique. Compartmental analysis was employed to analyze the xenon washout curve. Three components were defined: a first component taken to represent cortical blood flow; a second component taken to represent medullary blood flow; and a third component assumed to represent blood flow in perirenal tissues. Estimation of renal blood flow by the xenon-133 washout technique can provide a good index of renal hemodynamics. The test can be performed conveniently and can provide significant information to supplement that obtained by other methods. Further clinical evaluation of this method is warranted. (ERB)

33614 SHORT-LIVED ISOTOPES. Umegaki, Y. (National Inst. of Radiological Sciences, Chiba (Japan)). Rinsho Kagaku; 10: No. 9, 1229-1234(Sep 1974). (In Japanese).

Short-lived isotopes used in clinical medicine were summarized. Milking generators can be conveniently used, because radioisotopes can be used immediately after separating and refining them in each facility. Technetium-99m, a representative nuclide produced by milking generators, is largely used for the examination of nuclear medicine, and the amount used shows a yearly increase. However, it accumulates as ^{99m}Tc. Therefore, it is necessary to develop other nuclides instead of ^{99m}Tc. Carbon-11, ^{13}N, and ^{15}O which are produced by cyclotron and are able to be used for clinical application, are noticed because those are elements of composition of human being. Most of nuclides produced by cyclotron show extremely short half-lives. Gallium-67 and ^{111}In are available for diagnosis in the cases with malignant tumor, because it is possible to export them as those half-lives are more than 2 days. Fluorine-18 can be most easily produced by cyclotron, and is suitable for the diagnosis in the cases with bone diseases by administering it with the form of Na^{18}F. In ^{123}I, there are many advantages from the point of half-life and γ-ray energy. Therefore, use of ^{123}I is of very wide application. Iron-52 is the best isotope of Fe for clinical application. When it is possible to produce isotope such as ^{11}C, ^{13}N, ^{15}O, and ^{18}F, the synthesis of compounds labelled with these isotopes and the application as radiopharmaceuticals are able to be promoted, and the further development can be expected. (JA)

33615 CLINICAL APPLICATIONS OF hCG RADIOIMMUNOASSAY USING hCG BETA-SUBUNIT ASSAY SYSTEM. Kayama, K.; Toda, K.; Kamada, T.; Miyata, J.; Isojima, S. (Hyogo Coll. of Medicine (Japan)). Hyogo Ika Daigaku-Shi.; 3: No. 1, 37-42(Sep 1974). (In Japanese).

Human chorionic gonadotropin(hCG) radioimmunoassay could not differentiate hCG from lutenizing hormone(LH) because of their cross reacting antigen. Recently, α and β-subunit of hCG were separated and the β-subunit was found to possess the hCG specific biological activity and antigenicity, thus hCG specific assay using hCG β-subunit and anti β-subunit system was tried. The hCG β-subunit was iodinated with ^{125}I and unlabeled ^{125}I was separated by Bio Gel P-60. Anti-hCG β-subunit was absorbed with hCG α-subunit. 0.1 ml of standard hCG or patient's serum, 0.1 ml of anti hCG β-subunit, and 0.1 ml of ^{125}I-hCG β-subunit were mixed and reacted for 48 hrs at 4°C, and then 0.1 ml of anti-rabbit γ-globulin serum was added and kept for 24 hrs at 4°C. The resulting precipitate was centrifuged and counted. By this assay system, at least five times as much LH was necessary to interfere with the reaction system compared with the regular hCG radioimmunoassay, thus the hCG could be assayed without any interference of LH, when the reaction sensitivity was adjusted properly. In clinical application of this assay system, it was found that the postmenopausal women's serum did not show any inhibition, but pregnant serum showed the same inhibition curve as the standard hCG. After injection of LH-RH to women, no inhibition was observed, even though LH went up to 320 mIU/ml in the serum. By this assay system, the cellular response of hCG was also found as in the regular hCG radioimmunoassay. (auth)

33616 THE BONE SCINTIGRAPHY WITH ^{99m}Tc-LABELED PHOSPHORUS COMPOUNDS. Yamamoto, I.; Morita, R.; Mori, T.; Sakamoto, T.; Torizuka, K. (Kyoto Univ. (Japan). Faculty of Medicine). Radioisotopes (Tokyo); 23: No. 11, 614-619(Nov 1974). (In Japanese).

A fundamental and clinical comparative study of three kinds of ^{99m}Tc-labeled phosphorus compounds-^{99m}Tc-polyphosphate, ^{99m}Tc-phyrophosphate and ^{99m}Tc-diphosphonate (EHDP)-, was made and the diagnostic efficiency of these agents in metastatic bone tumors is discussed. Paperchromatographic study revealed the labeling efficiency of ^{99m}Tc-polyphosphate was 70% which was worse than those of ^{99m}Tc-pyrophosphate and ^{99m}Tc-diphosphonate in both of which more than 95% of ^{99m}Tc was labeled. A comparison between ^{99m}Tc-pyrophosphate and ^{99m}Tc-diphosphonate in the rat organs 3 hours after i.v. administration revealed that the distribution of ^{99m}Tc-diphosphonate was less than that of ^{99m}Tc-pyrophosphate in the soft tissue such as the blood or the muscle. The spine/blood uptake ratio was 9.3 in ^{99m}Tc-diphosphonate and 5.0 in ^{99m}Tc-pyrophosphate. The disappearance of the radioactivity from the blood in human was essentially the same in ^{99m}Tc-pyrophosphate and ^{99m}Tc-diphosphonate which were faster than that in ^{99m}Tc-polyphosphate. Clinically, with ^{99m}Tc-polyphosphate, the thyroid or the liver was occasionally imaged but was seldom with the other two agents. No essential difference was found in bone imaging between ^{99m}Tc-pyrophosphate and ^{99m}Tc-diphosphonate. Bone scintigrams of the metastatic bone tumors taken with these three agents were compared with bone x-ray photo and value for serum alkaline phosphatase. Of 28 cases of positive scintigram, 9 cases had no abnormal lesions on x-ray photo and 11 cases had negative x-ray lesions and positive scan lesions as well as positive x-ray and scan lesions. All of these scan positive lesions had been strongly suspected of bone metastases by symptoms and histories but not proved histologically. As was said about ^{85}Sr, ^{87}Sr, ^{18}F, and other agents, the scintigraphy with ^{99m}Tc-labeled phosphorus compounds was more useful in early diagnosis of bone metastasis than x-ray examination or value for serum alkaline phosphatase. (auth)

33617 LUNG SCINTIPHOTO BY MEANS OF TECHNETIUM MAA KIT. Kaneko, M.; Sasaki, T.; Watanabe, M.; Fujita, T.; Tanaka, Y. (Nagoya Univ. (Japan). Hospital). Radioisotopes (Tokyo); 23: No. 11, 640-645(Nov 1974). (In Japanese).

Lungs are obviously most strongly influenced organs by respiration, because of their own movement. ^{99m}Tc-MAA is easily obtained by only adding sterilized ^{99m}Tc-pertechnetate into the MAA vial containing MMA and stannous chloride in acetate buffer. By injecting this ^{99m}Tc-MAA, multi-directional lung scintiphotos, that is, frontal, both laterals, and posterior view of the lungs are obtainable safely and rapidly, even during the breath holding, resulting in good clinical information by the better quality of the images. Sixty-nine cases are subjected to study. Group I consists of 22 cases of lung cancer and other cancers which have invaded hilar lymph nodes; Group II, 16 cases of postoperative breast cancer to be examined radiation effect upon the apex; Group III, 23 cases of mitral stenosis and congenital heart disease; Group IV, 8 cases of acrotitis syndrome and others. Exactly knowing the distribution of ^{99m}Tc-MAA perfusion in the lungs, elucidation of pathophysiology of these diseases is greatly supported. In the Group II, "Apex View" is newly considered for better observation of apical blood flow. This technique is performed by placing the scinticamera head facing to the back of the patient posteriorly with 30° of inclination. Before and after irradiation therapy, this technique is applied to the investigation of a more innocuous method of irradiation to the supraclavicular region. (auth)

33618 STUDIES ON DRUG METABOLISM BY USE OF ISOTOPES. XIII. Isotope Effect on Metabolism of Deuterated 1-Ephedrine. Kawai, K.; Baba, S. (Tokyo Coll. of Pharmacy (Japan)). Chem. Pharm. Bull. (Tokyo); 22: No. 10, 2372-2376 (Oct 1974).

Isotope effects, one of the problems on the applicability of a drug labeled with deuterium on the benzene ring to the metabolic studies in man, were investigated. 1-Ephedrine [α-^{14}C, arom.-$^{2}H_5$] or 1-ephedrine [α-^{14}C] was subcutaneously injected to rats and rabbits, and the urine excreted during 24 hr after dosing was submitted to the inverse isotope dilution analysis. The urinary excretion of ^{14}C activity in rats or rabbits given the deuterio-compound was not significantly different from that given the protio-compound. No significant difference was observed in the amount of main urinary metabolites (in rabbits, 1-phenyl-1, 2-propanediol and hippuric acid, and in rats, p-hydroxyephedrine) between the deuterio- and the (protio-drug) except an amount of unchanged ephedrine which was excreted more by rats receiving deuterated ephedrine. The increased excretion of unchanged ephedrine after dosing of the deuterated compound did not seem to be due to deuterium-isotope effect by another experiment using a mixture of 1-ephedrine [α-^{14}C, arom.-$^{2}H_5$] and 1-ephedrine [arom.U-$^{3}H_1$]. (auth)

33619 STUDIES ON RADIOIMMUNOASSAY FOR THYROID HORMONES. Fukuchi, M.; Matsuoka, T.; Kido, A.; Nagai, K. (Hyogo Coll. of Medicine (Japan)). Hyogo Ika Daigaku-Shi.; 3: No. 1, 1-9(Sep 1974). (In Japanese).

In an attempt to obtain antisera for radioimmunoassay of thyroid hormones, rabbits were immunized with human thyroglobulin in Freund's complete adjuvant. Nine weeks after immunization, thyroxine(T_3)-Sepharose 4B or triiodothyronine(T_4)-Sepharose 4B was injected at two weeks interval for several weeks. After the potency of antibodies against T_3 or T_4 obtained by two-step immunization was examined, the application of these antisera to radioimmunoassay of thyroid hormones was studied. It was sufficiently sensitive to measure 0.05 ng of unlabeled T_3, and 0.1 ng of unlabeled T_4. Cross reactions with T_4 in T_3-radioimmunoassay system and with T_3 in T_4-radioimmunoassay system were negligible. With the use of these antisera, it was possible to develop a radioimmunoassay system for the simultaneous measurement of T_3 and T_4 in 0.025 ml of unextracted serum. Comparisons of T_3 and T_4 values obtained by simultaneous measurement with the values assayed by each radioimmunoassay system afforded excellent agreement. The accuracy and specificity of these systems is thought to be very useful for routine clinical determinations and for research applications. (auth)

33620 FUNDAMENTAL STUDY FOR THE ESTIMATION OF PLASMA RENIN ACTIVITY. Era, Y.; Kasama, J.; Nakagawa, T. (Shizuoka Central Prefectural Hospital, Takajo (Japan)). Radioisotopes (Tokyo); 23: No. 7, 380-384(Jul 1974). (In Japanese).

Estimation of the renin concentration in human plasma is of increasing importance in the clinical evaluation of hypertensive disease. Fundamental experiments were carried out on estimation of plasma renin activity (PRA) using radioimmunoassay technique for angiotensin I. A linear generation slope was found during first 2 hours incubation and slightly decreasing slope after 2 hours. Normal values were obtained from 7 male and 8 female normal subjects on unrestricted diet. Normal male had mean and standard deviation of 0.9 ± 0.5 ng/ml/h at rest 1.8 ± 0.8 ng/ml/h on upright posture. Normal female in follicular phase had 0.5 ± 0.3 ng/ml/h at rest, 1.3 ± 0.7 ng/ml/h on upright, while those in luteal phase had 1.8 ± 0.7 ng/ml/h at rest, 3.3 ± 0.6 ng/ml/h on upright. There was significant difference between PRA in follicular phase and that in luteal phase in each of the postures ($p < 0.005$ respectively). The response of PRA to combined stimula of intravenously injected Furosemide (20 mg) and ambulation was determined in two normal male subjects. The response was more than three times the base, reaching plateau after 1 hour of the stimula. This technique seemed to be convenient for routine PRA examination. (auth)

33621 CLINICAL SIGNIFICANCE OF HUMAN THYROID STIMULATING HORMONE (HTSH). Okita, N.; Kondo, S.; Yamasaki, S.; Sano, H.; Mannen, T. (Kurume Univ., Fukuoka (Japan). School of Medicine). Radioisotopes (Tokyo); 23: No. 7, 385-390 (Jul 1974). (In Japanese).

The effects of synthetic thyrotropin-releasing-hormone (TRH) intravenously injected in a dose of 500 μg on serum immunoreactive TSH levels were studied in 81 subjects with nontoxic goiter, hyperthyroidism, hypothyroidism, or others and 15 normal subjects. Basal levels of serum TSH in normal subjects were below 10 μU/ml and reached maximum levels by 30 minutes with a mean of 21.3 ± 6.2 μU/ml following TSH administration. Serum TSH levels in subjects with primary myxedema were elevated and rose further following TRH administration, a patient with Sheehan's syndrome showed low response and most of patients with hyperthyroidism no response. A patient with acromegaly showed low response and subjects with Klinefelter's syndrome or Turner's syndrome showed normal response to TRH. A patient with cerebellar disorder treated by glucocorticoid showed an inhibition of TSH response to TRH. (auth)

33622 LIVER SCINTIGRAPHY WITH SCINTILLATION CAMERA. Comparison Between ^{99m}Tc-Sn-Colloid and ^{99m}Tc-Phytate. Aburano, T.; Ueno, K.; Watanabe, H.; Hisada, K. (Kanazawa Univ. (Japan). School of Medicine). Radioisotopes (Tokyo); 23: No. 7, 391-394(Jul 1974). (In Japanese).

Criteria were previously reported of degree of splenic visualization on anterior liver scintigram with ^{99m}Tc-compounds, for the diagnosis of diffuse hepatic disease. Evaluation from anterior liver scintigram, however, has the problem that the degree of splenic visualization is subjected to the distance from the detector. For the solution of this problem, comparison of spleen-to-liver activity ratios was done between anterior and posterior views, and good correlations [a) ^{99m}Tc-Sn-colloid: r = +0.89, b) ^{99m}Tc-phytate: r = +0.60] were obtained between these two ratios. The effect of distance from the detector was considered to be negligible from these results, and the evaluation from anterior view was concluded to be satisfactorily effective in diagnosis of diffuse hepatic disease. Furthermore, comparison between ^{99m}Tc-Sn-colloid and ^{99m}Tc-phytate was done in performing multiple-view scintigraphy with a scintillation camera. In case of ^{99m}Tc-Sn-colloid, splenic images were more clearly visualized than those using ^{99m}Tc-phytate. Splenic size with ^{99m}Tc-phytate was considered to be influenced with the degree of splenic uptake because of a good correlation between spleen-to-liver activity ratio and splenic size, whereas a poor correlation in case of ^{99m}Tc-Sn-colloid. From these two results, ^{99m}Tc-Sn-colloid was considered to be more effective than ^{99m}Tc-phytate in evaluation of both spleen and liver images. (auth)

33623 GROWTH RESPONSES OF RICE PLANTS TO ENVIRONMENTAL CONDITIONS. IV. The Effect of Air- and Soil-Temperature Upon Translocation and Distribution of ^{14}C. Sato, K. (Tohoku Univ., Sendai (Japan). Faculty of Agriculture). Nippon Sakumotsu Gakkai Kiji; 43: No. 3, 410-415(Sep 1974). (In Japanese).

The effects of air- and soil-temperature, regulated separately, on translocation and distribution of ^{14}C photosynthate in rice plants were studied. Norin-17, which is a japonica variety adapted to Tohoku district, was used at its vegetative growth stage. Higher air-temperature increased the percentage of ^{14}C assimilates translocated from (the fed) leafblades, but the effect was not so evident. Relatively more assimilates were translocated and recovered at unexpanded young leaves at higher air-temperatures, but at lower air-temperatures they were distributed more at leaf-sheath, stem and roots, parts of them being stored there as sugars and starch. In general, high soil-temperature showed a tendency to stimulate the distribution of ^{14}C in roots. It was concluded that higher T/R and LB/TOP ratios generally induced under higher air-temperatures were related to faster translocation and greater distribution of assimilates at unexpanded young leaves which behaved as a strong "sink" under these conditions. (auth)

33624 THE UPTAKE, DISTRIBUTION, AND ACCUMULATION OF ^{15}N-LABELED AMMONIUM AND NITRATE NITROGEN TOP-DRESSED AT DIFFERENT GROWTH STAGES OF RICE. Muhammad, S.; Kim, U. J.; Kumazawa, K. (Tokyo Univ. (Japan). Faculty of Agriculture). Soil Sci. Plant Nutr. (Tokyo); 20: No. 3, 279-286(Sep 1974).

A pot experiment with soil culture was carried out to trace ^{15}N-labelled nitrogen top-dressed at different growth stages of rice. The study involves the use of a modified vacuum system for determining total nitrogen by gas volumetric measurement, and the N_2 gas sampled in the discharge tube was analyzed for nitrogen-15 by the optical spectrographic technique. The plants took up more nitrogen from $(^{15}NH_4)_2SO_4$ than from $Na^{15}NO_3$, irrespective of the stage of dressing, and the uptake of both forms was much higher when the plants were top-dressed at the young panicle formation stage as compared with the later dressings. At full maturity the plants had the highest accumulation of labelled nitrogen from both ammonium and nitrate sources when they are top-dressed at the young panicle formation stage. More than 80% of the labelled nitrogen taken up by the plants was distributed in the brown rice and this trend was more remarkable when top-dressing was carried out at the milk stage. The distribution patterns of ammonium and nitrate nitrogen were similar in brown rice but differed in leaves and stem. Nitrogen transported from other parts to the panicle was utilized for the formation of the husk until the booting stage, and then for brown rice development. With the completeness of husk formation, at the milk stage, nitrogen transported to the grain might have been utilized for brown rice development more rapidly. In the brown rice, nitrogen from ammonium was translocated maximally to the inner part of the endosperm from dressing at the booting stage, and to the embryo from that at the milk stage, whereas that from nitrate was translocated maximally to the embryo from the dressings at both stages. (auth)

33625 RADIOIMMUNOASSAY OF PLASMA PROGESTERONE WITHOUT CHROMATOGRAPHY. Garza, R.; Burns, B.; Manlimos,

F.; Abraham, G. (Harbor General Hospital, Torrance, CA). Anal. Lett.; 8: No. 4, 225-232(Apr 1975).

A radioimmunoassay method for the measurement of progesterone (P) in plasma after selective solvent extraction with hexane is described. Utilizing specific antisera against P with minimal or no cross reaction with other steroids, P was measured accurately in a volume of 0.5 ml of plasma. The range of P levels that could be measured per ml of plasma in the assay system described varied from 0.04 to 40 ng/ml. Comparison of the P levels obtained by this rapid assay and by a proven chromatographic system suggests adequate specificity of this quick method. (auth)

33626 MEASUREMENT OF CARDIAC OUTPUT BY CONSTANT INJECTION OF RADIOACTIVE XENON: STUDY ON A MECHANICAL HEART MODEL. Avasthey, P. (G. S. V. M. Medical Coll., Kanpur (India). Dept. of Cardiology). Indian J. Med. Res.; 62: No. 6, 886-892(Jun 1974).

A method for repeated measurement of cardiac output by constant injection of ^{133}Xe solution in the right atrium and collection of a sample from the pulmonary artery is described. The validity of the method was verified on a mechanical heart model. The advantages of this method over the conventional Fick and single instantaneous injection indicator dilution methods are discussed and the usefulness of the technique in transient states demonstrated. Cardiac output values obtained by this technique agreed well with those obtained by direct measurement. The few limitations of the method are also pointed out. (auth)

33627 TOMOGRAPHIC IMAGING IN NUCLEAR MEDICINE. McRae, J.; Anger, H. O. (University of California, Berkeley). pp 189-213 of Recent Advances in Nuclear Medicine. Volume XVII. Lawrence, J. H. New York; Grune and Stratton, Inc. (1974).

The present methods of tomography function best for imaging areas of relatively high concentration of isotope rather than for displaying areas of decreased uptake. Section images of the brain provide valuable information that cannot be gained from conventional rectilinear scans or scintiphotos. Focal-plane tomography with multiple readouts focused at different depths appears particularly promising in bone imaging and tumor surveys using tumor-specific agents. There is a continuing need in nuclear medicine for better methods for imaging the distribution of radioactive tracers within the body. Progress is being made. As new radiopharmaceuticals are developed which trace the diverse functions of the different organs of the body we will gain additional valuable distribution of the tracer. This three-dimensional information is important for both static and dynamic studies. (auth)

33628 RETROGRADE RADIOISOTOPE MYOCARDIAL PERFUSION PATTERNS IN DOGS. Cibulski, A. C.; Markov, A.; Lehan, P. H.; Galyean, J. R.; Smith, R. O.; Flowers, W. M. Jr.; Hellems, H. K. (Univ. of Mississippi, Jackson). Circulation; 50: No. 1, 159-166(Jul 1974).

A retrograde coronary vein injection technique for concentrating radioisotope in ischemic myocardial regions was evaluated in dogs. Potassium-43 in saline solution was injected into the coronary veins during complete closure of the coronary sinus. In the presence of coronary inflow obstruction, the venous potassium-43 was distributed mainly to the low pressure vessels in ischemic heart regions; i.e., the ratio of potassium-43 in the occluded-to-unoccluded areas ranged from 2 : 1 to 3 : 1 thirty seconds after retrograde injections. Krypton-85 in saline solution was injected under pressure into the coronary veins during partial closure of the coronary sinus. In the presence of inflow obstruction, the ratio of krypton-85 in the occluded-to-unoccluded areas ranged from 4 : 1 to 6 : 1 sixty seconds after retrograde injections; larger ratios may be expected after rapid washout of gas from the normally perfused region is nearly complete. Myocardial potassium-43 imaging techniques were applied to locate and measure the size of the ischemic heart region as a radioisotopic hot spot. Detection of hypoperfused areas of extremely small size may be accomplished by this technique. (auth)

33629 RADIOACTIVE ISOTOPES IN CLINICAL MEDICINE AND RESEARCH. Conference Held at Bad Gastein, Austria, January 8-11, 1974. Hoefer, R. (ed.). Sonderbaende aur Strahlentherapie, Band 74. Munich; Urban und Schwarzenberg (1975). 544p. (In several languages). (CONF-740120-).

Separate abstracts were prepared for 39 of the 63 papers presented in these proceedings. The other 24 papers discuss the use of tracer techniques in medicine and the pharmacology of various drugs used in the preparation of radiopharmaceuticals. (ERB)

For abstracts of individual papers see: 32475, 32476, 32502, 32641, 32642, 32667, 33191-33194, 33532-33534, 33537, 33546, 33547, 33557-33561, and 33630-33647.

33630 SOME STUDIES OF THE DOSIMETRY AND SAFETY OF RADIOPHARMACEUTICALS. Trott, N. G.; O'Connell, M. E. A.; Ross, H. A.; Smith, P. H. S.; Taylor, D. M. (Royal Marsden Hospital, Sutton, Eng.). pp 1-18 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

In the clinical applications of radionuclides it is always necessary to attempt to evaluate the absorbed dose delivered to various organs per unit activity administered. Confidence in the values derived from appropriate physical and biological data is of particular importance in applications to work with scanners of γ-cameras, since here one may wish to administer comparatively large activities in order to obtain images of satisfactory quality; it is also particularly important in diagnostic tests on young people and, of course, in any applications to therapy. We have recently had occasion to examine the dosimetry of a number of radioactive compounds undergoing initial trial at this Hospital and Institute, including ^{67}Ga-citrate, ^{111}In-Bleomycin, ^{99m}Tc-polyphosphate, ^{99m}Tc-heat damaged erythrocytes, ^{18}F-fluorophenylalanine (FPA), ^{195m}Pt cis-dichlorodiammine platinum II (DDP), ^{32}P/^{131}I-Lipiodol, and ^{90}Y-DTPA. A comparative analysis is given of the various techniques adopted for dosimetric studies, including work with laboratory animals, clinical measurements using a whole-body scanner with digital read-out, and other systems. Problems of extrapolating animal data to man and of securing the necessary clinical measurements are discussed and an assessment is made of the form and scope of the physical data at present available. The general problem of assessing the safety of a radioactive compound for clinical applications is also briefly discussed with particular reference to the difficulties that arise in dealing with short-lived radionuclides. (auth)

33631 RADIATION DOSES FROM ^{133}Xe AND ^{127}Xe USED FOR LUNG FUNCTION INVESTIGATIONS. Ackery, D. M.; Goddard, B. A. (Southampton General Hospital, Eng.). pp 31-43 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Xenon-127 appears to have a number of advantages over ^{133}Xe for clinical work. It has no beta-emission, and its mean internal conversion electron energy loss per transformation (0.012 MeV) is ten times less than for the mean beta energy loss of ^{133}Xe (0.128 MeV). The principle electromagnetic emission of ^{127}Xe is around 200 keV (87% of transformations) which is more suitable for a scintillation camera than the 81 keV of ^{133}Xe (37% of transformations). The physical half-life of ^{127}Xe is 36.4 days, which is long compared to that of ^{133}Xe (5.3 days); but the biological half-life of the gas in the lungs is short, and will determine the effective half-life in the body. Calculations have been made to assess the dosimetric advantages of ^{127}Xe over ^{133}Xe in studies of ventilation and blood perfusion of the lungs. The following technique has been considered: a single breathhold of xenon in 100% oxygen (1 μCi ml^{-1}) of 30 seconds, followed by washout of gas; tidal rebreathing from a closed circuit containing xenon in oxygen (1 μCi ml^{-1}) for 3 minutes, followed by wash-out; and intravenous injection of dissolved xenon (1 mCi in 10 ml of saline), followed by breathhold (30 seconds) and wash-out. In order to calculate radiation doses a model is proposed which will enable the specific activity time integral of gas within the lung for each procedure to be calculated. A single compartment lung model for wash-in and wash-out of xenon is taken. Using this model it is shown that the specific activity-time relationship is always equal to the product of the spirometer concentration and the rebreathing period, when the exponential rate constant for wash-in and wash-out is the same. Calculations of radiation doses received during the lung function investigations show that the dose from ^{127}Xe is significantly less than that for ^{133}Xe. (auth)

33632 TECHNETIUM CITRATE AS A NEW RADIOPHARMACEUTICAL IN TUMOR DIAGNOSIS. Benes, I.; Heinzel, F.; Marwik, G.; Oppermann, H. C. pp 107-116 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

The processes by which a radiopharmaceutical is concentrated in tissues are still not completely understood, and attempts to produce tumor-specific radiopharmaceuticals are still based on empirical approaches. A positive tumor scintigram may either

be the result of increased uptake of the radiopharmaceutical in the tumor cells or its adsorption by an altered membrane structure. The ideal tumor-specific agent should fulfill the following criteria: it should be labelled with a suitable and readily available radionuclide; it should be in a suitable chemical form; it should not bind to the plasma proteins and should pass easily through the blood vessels into the interstitial space; it should be available at high specific activity; and the fraction not taken up by the tumor should be rapidly and efficiently cleared from the blood by the kidneys. For the distribution in the body and for the tumor-affinity, the structure of the whole molecule must be regarded as the limiting factor, especially the anionic part which plays a major role in determining the tumor affinity. Better results may be achieved by radiopharmaceuticals which exist in a relatively stabile complex, especially with organic acids. Based on these considerations, we have prepared a ^{99m}Tc-citrate complex with a rapid and high tumor uptake. This substance is especially useful for the visualization of brain tumors, bone tumors, and metastases. The preparation is simple and can be performed in almost any laboratory. The results obtained in various patients are demonstrated. (auth)

33633 LIVER SCANNING USING ^{67}Ga-CITRATE. Wood, E. J.; James, O.; Williams, H. S. (Royal Free Hospital, London). pp 117-128 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Since the initial observation of Edwards and Hayes that ^{67}Ga citrate localizes in soft tissue tumors, a number of reports concerning its use as a tumor scanning agent have appeared in the literature. While the majority of these reports have been concerned with the application of ^{67}Ga in the localization of lung and breast cancer and in the clinical management of the reticuloses, comparatively little work has been carried out on its application in the evaluation of liver pathology. Gallium-67-labelled citrate liver scans have been carried out as a complementary study to the routine ^{99m}Tc colloid scan in 61 patients with liver disease. Of particular interest are the studies on patients with suspect primary liver cancer or liver abscess, and in many cases, very striking uptakes of ^{67}Ga citrate have been observed in the region of filling defects seen in the corresponding routine scan. Patients with other liver pathologies, including cirrhosis, malignant melanoma, hydatid cyst, and amyloidosis have also been studied. The findings of the liver scans will be correlated where appropriate with those of the relevant biochemical and histological investigations and conclusions drawn to support the continued application of ^{67}Ga citrate in liver scanning in selected patients showing defects on the routine scan. (auth)

33634 PHARMACOKINETICS OF RADIOIODINE-LABELLED ORGANIC MERCURY COMPOUNDS. Deckart, H.; Herzmann, H.; Flentje, H.; Blottner, A.; Schwartz, K. D. (Radiologische Zentrum des Staedt, Klinikum, Berlin). pp 134-141 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Because of their high affinity for the kidneys, organic mercury compounds are used as radiopharmaceuticals for static renal and brain scintigraphy. The disadvantages of such compounds are limited shelf life (in the case of ^{197}Hg compounds) and a high radiation dose (in the case of ^{203}Hg). The kinetic behavior of these mercury compounds is similar when they are labelled with radioiodine. Similar chemical and pharmacological behavior of compounds containing stable mercury and radioiodine makes it possible to label mercury compounds with the more advantageous radioisotopes of iodine. Examples of such benzoic acid and benzene-sulphonic acid derivatives are presented. It is shown that the absence of mercury in the aromatic ring results in changed kinetic behavior. It is also shown that an affinity for the kidneys results not only, as in the already known aliphatic mercury compounds (chlormerodrin, Mersalyl for example), from an aminopropyl-mercury group, but also from a mercury group in the aromatic ring. In these preparations, a partial splitting of the mercury label is observed. (auth)

33635 DIAGNOSTIC VALUE OF THE FILTRATION CLEARANCE IN LATE-TOXICOSIS SYNDROMES OF PREGNANCY BY MEANS OF RADIOINDICATORS. Slavov, I.; Ignatov, A. (Medical Faculty, Plovdiv, Bulgaria). pp 152-158 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Various tracers (^{125}I-Iothalamate, ^{169}Yb-EDTA, and ^{58}Co-DTPA) have been used to measure glomerular filtration rates in late toxemia of pregnancy (during the last trimester). The values obtained (10 patients) were higher (144.8 ± 23.4 ml/min) than those in non-pregnant patients (115.3 ± 13.3 ml/min). Higher than normal values were also obtained in cases when pyelonephritis co-existed with pregnancy (129.5 ± 33.4). In late toxemia, the rise in filtration rate was related to the severity of the symptoms viz: 101.0 ± 41.6 ml/min in mild forms (5 patients); 61.2 ± 17.3 ml/min in severe form of pre-eclampsia (11 patients); and 48.0 ± 19.6 ml/min in eclampsia (3 patients). The advantages of this type of investigation in comparison with conventional methods are discussed. (auth)

33636 PENICILLAMINE-INDIUM: SCINTIGRAPHIC AGENT FOR RENAL EXPLORATION. Morcellet, J. L.; Baret, A.; Le Mignant, A.; Koenig, R. (Centre d'Etudes et de Recherches Biophysiologiques, Toulon, France). pp 159-173 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In French).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

An investigation of the biophysiological properties of the penicillamine-indium is presented. Its preparation is rapid with an output near the unit. In man, it disappears from the plasma within a few minutes. Within 15 minutes after injection, 30% is removed by the kidneys, its activity being either settled at the level of distal nephron or found in the urine in a complex form. The plasma activity is then bound for 95% to a beta-1-globulin as of indium-transferrin. This may be metabolized by the liver and excreted in the bile. The activity of the liver begins to be significant on the 2nd day only. The 7% settled in the kidneys allows excellent scan images from the 30th minute on, when the urinary activity has already lost its acuteness in the pyelocalycial cavities, their background being no longer sensitive. (auth)

33637 MEASUREMENT OF INDIVIDUAL RENAL FUNCTION: A COMPARISON OF A GAMMA-CAMERA-COMPUTER-LIGHT-PEN-SYSTEM WITH BACKGROUND SUBTRACTION RENOGRAPHY. Britton, K. E.; Hall, F. M.; Wells, P.; Cox, N. J.; Goodwin, T. J.; Bluhm, M. M. (Kent and Canterbury Hospital, Kent, Eng.). pp 186-195 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

In 27 patients, automatic analog computer assisted blood background subtraction (CABBS) renography was performed using an N. E. Renography 3 probe system at St. Mary's Hospital, London (10 μCi RIHSA and 20 μCi ^{131}I-Hippuran) or a similar J & P system at Kent and Canterbury Hospital (KC) (20 μCi ^{113m}In and 20 μCi ^{131}I-Hippuran). Gamma camera studies were performed at KC using a Radicamera 50, Nukab 2530 data processor, TV display system incorporating a PDP8E RK 800,000 word disc and a light pen. An hour after injection of ImCi Tc-DTPA, data was collected and displayed in color mode. The left and right kidney areas were overwritten with the light pen and the total counts (L and R) and number of elements (C_1 and C_3) in each area determined. Background areas were circumscribed around the L and R kidney regions and the total counts (B_L and B_R) and the number of elements (C_2 and C_4) were determined. In 10 patients standard divided renal function studies were done. (auth)

33638 SIGNIFICANCE OF THE ORGAN DEPTH FOR UNILATERAL QUANTITATIVE KIDNEY STUDIES. Erd, W.; Havlik, E.; Salambaschev, L.; Hoefer, R. pp 196-202 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Several methods have been described for the quantitation of renal function by external monitoring including body-background correction for the count rates registered over the kidneys. Generally, however, no correction is applied for kidney depth. From phantom measurements, a half value layer was calculated of 6.2 cm from the absorption curve obtained for ^{131}I. Using these results, the possibility was investigated of estimating the depths of each kidney using the following method: after i.v. injection of ^{99m}Tc-DTPA (Renotec) the skin-kidney distance is determined using a point source, constant geometry, and a multichannel analyzer, with an exactness of ±6 mm. The integrated counts collected during the secretion phase of an ^{131}I-hippuran renogram

are now corrected for body background and organ depth. The results are expressed as per cent of total renal activity for each kidney and as per cent of total activity injected. It follows from these results that organ depth has an influence of up to 30% on the results of unilateral measurements. (auth)

33639 MEASUREMENT OF WHOLE BODY NITROGEN IN LIVING MAN BY NEUTRON ACTIVATION ANALYSIS. Harvey, T. C.; Thomas, B. J.; James, H.; Chettle, D. R.; Ettinger, K. V.; Dykes, P. W.; Jain, S.; Chen, N. S.; Fremlin, J. H. (Univ. of Birmingham, Eng.). pp 264-272 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Whole-body nitrogen was measured in living man by a new technique of pulsed neutron activation analysis. Patients are irradiated with cyclotron-produced fast neutrons, and the capture gamma spectrum resulting from the $^{14}N(n,\gamma)^{15}N$ reaction is detected by a series of on-line sodium iodide scintillators arranged about the subject. Phantom, cadaver, and human volunteer studies indicate that multiple serial measurements of body nitrogen can be made with a reproducibility of ±3% for a radiation dose of 10 mrads over an 18 month time interval. Some 100 patients were studied on over 300 occasions, and the findings are presented. The potentialities and scope of the system for medical research purposes are illustrated by a number of examples. Changes in total body nitrogen have also been compared to simultaneous changes in total body potassium (measured in a whole-body counter by the ^{40}K method); the relationship between nitrogen and potassium is discussed. The technique offers a valuable new approach to the study of metabolic disorders in clinical medicine and represents a significant advance in the field. (auth)

33640 MEASUREMENT BY A NEW METHOD OF THE TOTAL AND REGION BONE FIXATION OF CALCIUM IN PATIENTS WITH PAGET'S DISEASE TREATED WITH SALMON CALCITONIN. Bergmann, P.; Schoutens, A.; Corvilain, J. pp 301-308 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In French).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

A method for studying bone Ca metabolism is presented using whole-body counting. Bone Ca accretion is calculated from measurements of whole-body retention and serum specific activity during one week after intravenous injection of ^{47}Ca. Thus, not only the whole skeletal Ca accretion is measured, but also regions of the skeleton are focussed which are of particular interest, for instance, those which have normally a high Ca turnover rate or are the site of a localized pathological process. The method has been used for the comparison of bone Ca turnover rate in 13 normal subjects and in 6 patients with Paget's disease. The action of salmon calcitonin on calcium accretion was also studied during periods of 1 week to 3 months of treatment. (auth)

33641 RADIOCALCIUM STUDIES ON THE INITIAL EFFECTS OF CALCITONIN IN MAN. Caniggia, A.; Gennari, C. (Univ., Siena, Italy). pp 309-313 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

The major mechanism by which calcitonin (CT) lowers the serum calcium concentration is the inhibition of bone resorption. Nevertheless, there is evidence that the plasma disappearance curve of ^{47}Ca injected intravenously in man shows an acute increase a few minutes after intravenous injection of CT. This increase was found to involve both specific radioactivity and total radioactivity. A simultaneous, sudden increase of the urinary specific activity of ^{47}Ca was detected. Surface radioactivity measurements performed on soft tissues and bone demonstrated an increase in the soft-tissues radioactivity, with a simultaneous decrease of radioactivity counts from bone. The decrease of surface radioactivity counts from bone indicated that on administration of CT ^{47}Ca uptake was halted and radioactive calcium was leaving the bone. According to these data, two different mechanisms of action of CT could be considered: an early effect on bone cells producing a shift of calcium to the circulation and a later hypocalcaemic effect through diminution of bone resorption. These findings have been evaluated in normal and pathological conditions. The meaning of the initial effect of CT is discussed together with the opposite initial effect of parathyroid hormone. (auth)

33642 COMPARISON OF ^{99m}Tc-LABELLED POLYPHOSPHATE, PYROPHOSPHATE, AND ETHANE HYDROXY DIPHOSPHONATE IN PATIENTS WITH SKELETAL METASTASES AND IN NORMAL SUBJECTS. Citrin, D. L.; Bessent, R. G.; Tuohy, J. B.; Elms, S. T.; McGinlay, E.; Greig, W. R.; Blumgart, L. H. (Royal Infirmary, Glasgow). pp 321-328 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

The potential value of ^{99m}Tc-labelled phosphate bone scanning agents in malignant disease is well recognized. It is clearly important to establish which of the currently available compounds, polyphosphate, pyrophosphate, and ethane hydroxy diphosphonate, is the most efficient agent. We have studied 28 patients with known skeletal metastases (many with extensive disease) to compare the performance of polyphosphate (two different preparations), pyrophosphate, and ethane hydroxy diphosphonate. Each patient was studied on 2 or 3 occasions with a different compound. In addition to visual comparison of the gamma camera scans, tumor/bone radioactivity ratios were obtained directly from the gamma camera using a Multi-Channel Analyzer in 25 patients. The values for the same tumor areas using different compounds were compared. Blood clearance of the different radiopharmaceuticals was also compared in 12 cases. In addition to the patient studies, 10 healthy young volunteers were given 30 μCi of ^{99m}Tc-labelled polyphosphate, pyrophosphate, and E.H.D.P. Whole-blood levels, urinary excretion and whole-body retention were measured hourly for 6 hours and the results compared for each agent. Visual comparison of the scans showed little difference, although subjectively the pyrophosphate and E.H.D.P. scans were preferred. This impression was supported by the mean tumor/bone ratios found with the various agents in studies on the same patients. Results to date show that E.H.D.P. gave significantly higher ratios than pyrophosphate and either of the polyphosphates, while pyrophosphate was significantly better than D.I.I. polyphosphate, but no better than N.E.N. polyphosphate. In the metastatic patients, blood clearance of E.H.D.P. was significantly more rapid than pyrophosphate and polyphosphate, and this was also true of the control subjects. In the controls, urinary excretion of E.H.D.P. was higher, and whole-body retention was correspondingly lower. There was good correlation between patient (mCi) and control (μCi) blood levels, and we feel that this technique is a useful model for studying polyphosphate metabolism. Overall the combination of high tumor/bone ratios, lowered blood background, and rapid whole-body excretion suggests that E.H.D.P. is the phosphate bone scanning agent of choice at present. (auth)

33643 FIRST EXPERIMENTS WITH FUNCTIONAL SCINTIGRAPHY OF LACRIMAL DRAINAGE. Dressler, J.; von Denffer, H. (Technische Univ., Munich). pp 378-381 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

For the first time, the course of lacrimal drainage was bilaterally and simultaneously followed by means of a scintillation camera in a large number of patients (200 eyes were investigated) with various diseases of the anterior region of the eye. For this purpose 50 μCi ^{99m}Tc-pertechnetate in 0.02 ml isotonic solution was pipetted into the conjunctival sacs of the seated patient. An Anger camera with a pinhole collimator was used to observe the passage of the tracer, which was recorded on photoscintigrams. Time-activity curves obtained by the region-of-interest technique for the bulbus oculi, lacrimal sac and nasolacrimal duct by means of data processing system were then used for comparative functional studies. This method has proved valuable in cases of suspected stenosis of the lacrimal apparatus, the more so since, in contrast with dacryocystography physiological conditions of pressure and volume are maintained. Moreover, it provides exact information about the mean retention time of lacrimal fluid in relation to the introduction of ophthalmological drugs into the conjunctival sac. The radiation hazard is extremely low, so that studies may be repeatedly carried out and are also possible in infants. (auth)

33644 TOMOSCINTIGRAPHY BY GAMMA CAMERA. Lahneche, B.; Elizagaray, A.; Gerson, A.; Fleury-Goyon, M. C. pp 389-402 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975). (In German).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Since 1971, a tomoscintigraphic system for the gamma-camera in the Léon Bérard Centre has been used. This system permits simultaneous registration of four layers of sections with an equal separation of 0.5 inch, 1 inch, or 5 inches on x-ray film. The use of this tomoscintigraphic system on 150 patients has encouraged us to present the following considerations regarding the overall results and the disadvantages of this new technical approach. The overall performance of the system is promising. ^{99m}Tc activity administered and the duration of tomoscintigraphic examinations is in the same order as in conventional static scintigraphy with the scintillation camera. There is an improvement of the resolution in the horizontal plane: the resolution in depth is of the order of 1 cm. Tomoscintigraphic imaging permits the confirmations of the diagnosis of a void (sometimes at the limit of visibility of the scintillation camera), and improves the exact localization of the lesion in three dimensions and the determination of its extent. These features are very useful in the selection of a therapeutic plan (surgery, radiotherapy etc.). Tomoscintigraphic imaging sometimes produces artefacts: false voids and distortion of the image. Moreover, it is not possible with tracers emitting gamma rays of energy rays of energy below 0.16 MeV. The maximum diameter of the field of view is 22 cm. Further improvement is certainly possible using tracers emitting gamma rays of high energy and the enlargement of the field of view. (auth)

33645 INHERENT PROBLEMS IN DYNAMIC LUNG STUDIES. Munkner, T. (Rigshospitalet, Copenhagen). pp 403-417 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Dynamic lung studies have been performed after intravenous injection of ^{133}Xe, inhalation of ^{133}Xe, and/or intravenous injection of ^{99m}Tc-labeled human albumin microspheres. In order to evaluate the results, additional studies on dead-time losses, collimator characteristics, and on absorption and dispersion in the lungs and thoracic tissues have been carried out with gamma cameras as well as with an array of single detectors. The results have shown that it is extremely important to reduce the total dead-time of the equipment in order to obtain comparable results, and that the collimator design has to be a compromise between one with a broad field of view and one with optimal physical characteristics of the shielding. Finally, it is shown that the results obtained with arrays of single detectors are inferior to those obtained with the gamma camera, and that the best results as to isotropic response from all parts of the thorax can be achieved by simultaneous use of a frontal and dorsal gamma camera. The lung lesions may be so discrete that they are concealed by surrounding normal tissue when studied with individual detectors, and the perfusion and ventilation coefficients vary in different parts of the lung, in such a way that a good analysis of the pathological condition calls for a digital gamma camera analysis with a fine resolution. (auth)

33646 PHARMACOKINETICS OF A NEW PREPARATION OF BETAMETHASONE DISODIUM PHOSPHATE. Caravaggi, C.; Graziani, G. (Laboratori Glaxo Spa, Verona, Italy). pp 461-464 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

Plasma radioactivity levels, urine and fecal radioactivity excretion after treatment with a new oral long-acting preparation of betamethasone disodium phosphate are different from the data obtained after administration of the steroid in a normal release preparation. Its therapeutic significance is discussed. (auth)

33647 QUANTITATIVE DETERMINATION OF INTRACARDIAC SHUNTS WITH RADIOISOTOPE DILUTION TECHNIC. Tahti, E.; Riihimaki, E.; Perasalo, J.; Heiskanen, A. (Helsinki Univ. Hospital). pp 503-507 of Radioactive Isotopes in Clinical Medicine and Research. Hoefer, R. (ed.). Munich; Urban und Schwarzenberg (1975).

From 11th international symposium on radioactive isotopes in clinical medicine and research; Bad Gastein, Austria (8 Jan 1974). See CONF-740120-.

A method to determine left-to-right and right-to-left shunting flow by means of intravenous injection of ^{113}In, the use of a gamma-camera, and a digital data storage and processing system is described. Good correlation is found between the radioisotope method and cardiac catheterization results. (auth)

33648 USE OF RADIOISOTOPE TRACERS FOR THE DETECTION OF SOLUBLE PARASITIC ANTIGENS (FREE OR BOUND IN IMMUNE COMPLEXES). Houba, V. (Faculty of Medicine, Nairobi, Kenya). pp 13-18 of Nuclear Techniques in Helminthology Research. Vienna; International Atomic Energy Agency (1975).

From proceedings on the use of nuclear techniques in research and control of helminthic infections; Nairobi, Kenya (26 Nov 1973). See STI/PUB-390; CONF-731167-.

The advantages and limitations of the radioisotope tracer techniques used for the detection of antigens, antibodies and soluble immune complexes are briefly discussed, and a new modification of radio-immunoassay based on precipitation with polyethylene glycol is described. This technique has been applied to the detection of malarial antigens and/or immune complexes and in the separation of low-molecular from high-molecular IgM. (auth)

33649 HUMORAL FACTORS INFLUENCING LYMPHOCYTE RESPONSES: THEIR CLINICAL AND BIOLOGICAL SIGNIFICANCE. Nelson, D. S. (Univ. of Sydney). pp 19-39 of Nuclear Techniques in Helminthology Research. Vienna; International Atomic Energy Agency (1975).

From proceedings on the use of nuclear techniques in research and control of helminthic infections; Nairobi, Kenya (26 Nov 1973). See STI/PUB-390; CONF-731167-.

Transformation of lymphocytes into large proliferating blast cells, commonly assessed by measuring the increase in incorporation of radioactive precursors of DNA, RNA or protein, can be induced by a variety of stimuli and serves as an in vitro model for cell-mediated and other immunological phenomena. The extent of transformation can be profoundly influenced by humoral factors. Depression can be caused by: serum or plasma from patients with any of a wide variety of diseases; some normal sera; isolated fractions of normal serum or plasma; extracts of some tissues; products of some cultured cells; and some drugs. Facilitating or stimulating factors also occur. Depressive factors are heterogeneous and can act non-specifically or specifically. They are significant in several ways: failure to take them into account can distort the interpretation of laboratory studies of cell-mediated immunity; they may make a critical contribution to depression of cell-mediated immunity in patients with various diseases; they may adversely affect attempts at immunotherapy involving cell-mediated immunity; some may be of value in facilitating the establishment of allografts; some may have an important biological role in immuno-regulation. (auth)

33650 CHANGES IN LYMPHATIC EFFICIENCY IN FILARIAL-INFECTED PATAS MONKEYS STUDIED WITH ^{99m}Tc SULFUR COLLOID. Redington, B. C.; Thrall, J. H.; Dunson, G.; Johnson, M. C.; Sadun, E. H. (Walter Reed Army Inst. of Research, Washington, DC). pp 69-71 of Nuclear Techniques in Helminthology Research. Vienna; International Atomic Energy Agency (1975).

From proceedings on the use of nuclear techniques in research and control of helminthic infections; Nairobi, Kenya (26 Nov 1973). See STI/PUB-390; CONF-731167-.

Numerous investigators who have studied lymphatic-dwelling filarial worms have reported the use of radiographic lymphangiograms to help describe filarial disease in experimental animal infections. This technique, although useful for clearly detailing lymphatic vessels and nodes, has numerous shortcomings and provides the investigator little direct information on how well the lymphatic system is operating. In this report we introduce an isotopic technique that can be used to complement conventional lymphangiograms by quantitatively measuring the efficiency of the lymphatic system. The isotope used is the gamma emitter technetium-99m, which is attached to a sulphur colloid vehicle and suspended in normal saline. The model used is the Patas monkey infected with the filarial worm Brugia malayi. (auth)

33651 PRELIMINARY STUDIES ON ALBUMIN METABOLISM IN ETHIOPIAN SHEEP INFECTED WITH SCHISTOSOME BOVIS. Holmes, P. H.; Mamo, E.; Lemma, A. (Haile Sellassie Univ., Addis Ababa). pp 115-120 of Nuclear Techniques in Helminthology Research. Vienna; International Atomic Energy Agency (1975).

From proceedings on the use of nuclear techniques in research and control of helminthic infections; Nairobi, Kenya (26 Nov 1973). See STI/PUB-390; CONF-731167-.

Preliminary surveys in Ethiopia have shown that animal schistosomiasis caused by S. bovis occurs in cattle and sheep in at least three foci. So far little work has been done on this parasite in Ethiopia, but work in the Sudan shows that it can become a major veterinary problem and thus further investigations are justified. With the establishment of a Radioparasitology Unit under IAEA support in the Institute of Pathobiology at Haile

Sellassie I University in Addis Ababa, it became possible to study the effects of this parasite on plasma protein (albumin) metabolism of the host. Albumin turnover studies were first carried out on normal Ethiopian Highland sheep, and subsequently in animals infected with S. bovis. We were able to detect during the course of the infection a marked alteration in albumin catabolism, an increase in the plasma volume, a slight reduction in serum albumin levels, and a decrease in the extravascular pool of albumin. (auth)

33652 MECHANISMS INVOLVED IN OVINE SCHISTOSOMAL ANAEMIA. Preston, J. M. (London School of Hygiene and Tropical Medicine); Dargie, J. D. pp 121-126 of Nuclear Techniques in Helminthology Research. Vienna; International Atomic Energy Agency (1975).

From proceedings on the use of nuclear techniques in research and control of helminthic infections; Nairobi, Kenya (26 Nov 1973). See STI/PUB-390; CONF-731167-.

The onset and development of anaemia in sheep infected with 10,000 S. mattheei cercariae was studied over a 16-week period. The use of ^{125}I-labelled albumin demonstrated a progressive expansion of plasma volume from 4 weeks post infection, which accounted for the initial minor reduction in red cell parameters. ^{51}Cr-labelled red cell studies indicated a progressive fall in circulating red cell volume and a shortened half-life of red cells, which corresponded with a dramatic increase in the faecal radioactivity and the onset of egg production. Intravascular haemolysis was not a feature of the disease. Measurement of the red cell mass and enteric blood loss suggested some impairment of erythropoiesis and this was confirmed by the ferrokinetic indices. From between 4 and 8 weeks after infection the rate of incorporation of ^{59}Fe into red cells was reduced and infected animals showed no increase in plasma iron turnover, despite the loss of blood into the gastro-intestinal tract. Simultaneous studies with ^{51}Cr and ^{59}Fe showed that parasitized animals were unable to reutilize much of the iron lost into the gut, a factor that could eventually lead to an iron deficiency anaemia. (auth)

33653 USE OF RADIOACTIVE ISOTOPES IN THE STUDY OF SPECIFIC SCHISTOSOME MEMBRANE ANTIGENS. Kusel, J. R.; Sher, A.; Perez, H.; Clegg, J. A.; Smithers, S. R. (National Inst. for Medical Research, London). pp 127-143 of Nuclear Techniques in Helminthology Research. Vienna; International Atomic Energy Agency (1975).

From proceedings on the use of nuclear techniques in research and control of helminthic infections; Nairobi, Kenya (26 Nov 1973). See STI/PUB-390; CONF-731167-.

Adult Schistosoma mansoni were labelled in culture with ^{3}H leucine. Subsequently, labelled proteins were demonstrated in the surface membranes and later appeared in the culture medium. The proteins in the culture medium were reacted with hyperimmune rhesus monkey serum and these co-precipitated with rabbit anti-monkey IgG serum. The co-precipitates were analyzed by gel electrophoresis. Absorption studies with isolated adult surface membranes indicated that at least some of the culture medium proteins were antigenically identical with membrane turns over continuously in vitro and release of such proteins in vivo would lead to the induction of antibodies in the host. (auth)

33654 IMMUNOLOGICAL REACTIONS IN RABBITS EXPERIMENTALLY INFECTED WITH SCHISTOSOMA JAPONICUM. Williams, J. S.; Gore, R. W.; Sadun, E. H.; Bruce, J. I. (Walter Reed Army Inst. of Research, Washington, DC). pp 159-164 of Nuclear Techniques in Helminthology Research. Vienna; International Atomic Energy Agency (1975).

From proceedings on the use of nuclear techniques in research and control of helminthic infections; Nairobi, Kenya (26 Nov 1973). See STI/PUB-390; CONF-731167-.

Sixteen rabbits were exposed to a single dose of 150 Schistosoma japonicum cercariae each and 4 others were used as uninfected controls. Reaginic antibodies were demonstrated in the infected animals by passive cutaneous anaphylaxis tests, by antigen-induced histamine release and by a radioactive precipitin test (RAMP). There was an increase in complement beginning 6 weeks after exposure. Increased blastogenesis was demonstrated in all the infected animals by the use of tritiated thymidine uptake. Examination of skin biopsies obtained at various intervals following intradermal inoculation of cercarial, egg, metabolic and somatic adult antigens failed to provide a clear indication of delayed-type skin reactions. (auth)

33655 INVESTIGATION ON THE DETERMINATION OF UNSATURATED IRON BINDING CAPACITY USING RESIN STRIP. Nagase, K.; Maruo, K. (Juntendo Univ., Tokyo (Japan). School of Medicine). Radioisotopes (Tokyo); 22: No. 12, 707-713(Dec 1973). (In Japanese).

The method for determining unsaturated iron binding capacity (UIBC) using resin strip was investigated. This method can be performed at room temperature, and the limits of incubation temperature and time are not so strict. In case the room temperature is too low, it can be compensated by prolonging the incubation time accordingly. For the exact amount of serum being taken up, a fairly good reproducibility could be obtained. In the normal serum, the majority of UIBC values were 150 to 250 μg/dl, in cases with hyperthyroidism, however, the UIBC values were higher, while in cases with malignant tumor the UIBC values were within the normal range. (auth)

33656 INVESTIGATION ON THE DETERMINATION METHOD OF UNSATURATED IRON BINDING CAPACITY BY RES-O-MAT Fe KIT [UIBC]. Yonahara, Y.; Kirimura, H.; Takahara, Y.; Fukuiya, Y.; Kawato, M. (National Second Hospital of Tokyo (Japan)). Radioisotopes (Tokyo); 22: No. 12, 714-719(Dec 1973). (In Japanese).

A part of transferrin in serum is binding iron, and the rest of it is designated as unsaturated iron binding capacity (UIBC). The UIBC is defined as the capacity for binding iron. The sum of UIBC and serum iron content is total iron binding capacity (TIBC). In general, UIBC and serum iron content are in inverse proportion with each other, but the value of UIBC is also variable owing to the increase and decrease of transferrin. Although a lot of chemical methods have been applied to the determination of UIBC, it is troublesome to keep the experimental apparatus free of iron and it is not easy to prepare the standard solution of iron. For several years the authors have been employing the method using ^{59}Fe for the determination of UIBC. A few studies on this method were made, and the results are reported here. The differences in the duplicated determination of UIBC were found to be 0.2 to 32.0 (14.2) μg/dl. Notable differences were observed in case of hyperferremia. This indicates that much caution should be taken for the determination of UIBC which is of low value. Under consideration of the effect of temperature on the reaction rate, the preferred incubation time was studied at 22°C and 37°C. At 22°C the reaction continued along with time, while at 37°C the reaction reached a plateau after 30 min, and thereafter the rate of reaction was almost constant. The effect of skill in measuring of the serum volume on the value of UIBC was little in the case of hyperferremia, however it was very notable in the case of normal and hypoferremia. The serum iron content and the value of UIBC which were determined at the same time correlated inversely to each other, although there were variations in each case. The normal values of UIBC were found to be 153 to 265 (211 ± 37.5) μg/dl in 21 men and 148 to 275 (215 ± 32.8) μg/dl in 23 women, respectively. (auth)

33657 INVESTIGATION ON THE DETERMINATION OF TOTAL IRON BINDING CAPACITY OF SERUM USING RADIOACTIVE IRON ^{59}Fe. Kariyone, S.; Satoh, M.; Fujimori, K.; Miki, M.; Uchida, T. (Kyoto Univ. (Japan). Faculty of Medicine). Radioisotopes (Tokyo); 22: No. 9, 503-508(Sep 1973). (In Japanese).

The determination of total iron binding capacity of serum was investigated. The reagents were supplied from Daiichi Radioisotope Laboratories as a TIBC Kit. One ml of serum was added to a vial containing one ml of citric acid and Amberlite CG400 resin and then the vial was rotated for 15 minutes in order to isolate iron from transferrin and to remove it by the resin. By this treatment, almost 97 to 99 percent of serum iron was removed from transferrin. One ml of liquid layer of the vial was taken and was added to another incubation vial containing 3 μg of ^{59}Fe labelled ferric ammonium citrate. During 20 minutes of incubation, ^{59}Fe radioactivity of the vial was counted (A cpm). After the incubation, the resin strip was added and the vial was rotated for 90 minutes. After elimination of the resin strip ^{59}Fe radioactivity of the vial was again counted (B cpm). Then TIBC (μg/dl) = B/A × Fe(μg) × 200. The iron removal ratio was investigated using ^{59}Fe labelled serum as a tracer of the serum iron. Ninety seven to 99% of iron was removed from the serum after 15 minutes incubation. Three % of iron remained in serum with 20 μg/dl of serum iron, but only 1% of iron remained in serum with 300 μg/dl of iron, after the treatment. The amount of serum in the vial did not affect the amount of remaining iron. The changes of iron removal ratio in each citric acid vial with same serum were tested on seven samples and their TIBC values were determined. Both iron removal ratios and TIBC values showed quite similar results in every sample. Iron removal ratio somewhat decreased at 8°C. However, TIBC values showed no significant differences between 8°C and 37°C of temperature. There was a good correlation between the TIBC values by this method and TIBC values calculated from the amount of transferrin which were determined by immunological method. Also, there was a significant correlation between TIBC values by this method and by chemical method using magnesium carbonate. The determination of TIBC values of serum became easier than

before by the application of this method. Also, it gave correct values of TIBC and the data were quite steady for repeated determination. (auth)

33658 DETERMINATION OF UNSATURATED IRON BINDING CAPACITY USING RES-O-MAT Fe KIT UIBC. Sasaki, K.; Tanoue, T.; Yasudome, T. (National Central Hospital of Fukuoka (Japan)). Radioisotopes (Tokyo); 22: No. 9, 509-513(Sep 1973). (In Japanese).

The Res-O-Mat Fe Kit was developed to measure the unsaturated iron binding capacity (UIBC) using the resin strips for separating ^{59}Fe and free iron. The procedure of this kit was easy. This kit was recognized to be reliable as a result of the following investigation: time and temperature of incubation of transferrin and ^{59}Fe; time and temperature of incubation of resin strip and free ^{59}Fe; reproducibility; variance between the kits; effect of washing solution of instruments on UIBC values; correlation between this method and Irosorb; and clinical application. The normal values of each of 25 males and females were 177 ± 40 (109 to 260) μg/dl and 206 ± 39 (123 to 278) μg/dl respectively. (auth)

33659 INTERPRETATION OF CISTERNOGRAM WITH ^{169}Yb-DTPA WITH SPECIAL REFERENCE TO NORMAL ANATOMY. Akisada, M.; Miyamae, T.; Yamazaki, T. (Mitsui Memorial Hospital, Tokyo (Japan)). Radioisotopes (Tokyo); 23: No. 1, 38-45 (Jan 1974). (In Japanese).

In the past two years 100 cisternograms covering 90 patients using ^{169}Yb-DTPA as the radiopharmaceutical were performed at the Department of Radiology, Mitsui Memorial Hospital. The ^{169}Yb-DTPA was usually introduced into the lumbar intrathecal region and from the point the serial scintigrams were followed from the spinal canal to the parasagittal areas ranging from 30 minutes, 1, 3, 6, and 24 hours after the administration. In some cases 48 and 72 hour scintigrams were supplemented. The scintigrams were made using a Toshiba Universal dual scanner and scinticamera. Experiences with the interpretations of the cisternograms are summarized with special reference to normal anatomy, which must be studied as the fundamentals for the reading of the abnormal cisternograms under the pathologic conditions. The ^{169}Yb-DTPA cisternogram could be scintigraphically divided into the following regions; C. magna, basal cisterns, C. fossae sylvii, C. quadrigemina, lateral ventricles, and finally convexities and parasagittal areas. The characteristics of the shapes of these cisterns and lateral ventricles were discussed. The appearance time of the radiopharmaceuticals now available, i.e., ^{131}I-HSA, ^{169}Yb-DTPA in the adults and ^{99m}Tc-HSA in the children into each cistern was also discussed. (auth)

33660 DIRECT RADIOIMMUNOASSAY OF TRIIODOTHYRONINE IN HUMAN SERUM AND ITS CLINICAL SIGNIFICANCE. Seto, H.; Hisada, K. (Kanazawa Univ. (Japan). School of Medicine). Radioisotopes (Tokyo); 23: No. 1, 46-52(Jan 1974). (In Japanese).

Human serum triiodothyronine (T_3) was measured by "T-3 · RIA KIT" and its usefulness was evaluated in 108 subjects with or without thyroid abnormalities. This kit is designed using 8-anilino-1-naphthalene sulfonic acid (ANS) to block T_3-TBG binding for measurement of T_3 in unextracted serum. The antibody bound and free T_3 are separated with dextran-coated charcoal. Intraassay reproducibility, assessed by measuring the identical sample five times was 3.5%. Interassay variation, evaluated by determining seven paired specimens in three successive assays was 10.5%. The lower limit of sensitivity was always about 0.05 ng in 0.1 ml of hypothyroid serum and the range was 0.5 to 8.0 ng/ml. T_3 values observed are as follows: euthyroid 1.15 ± 0.28 (SD) ng/ml, hypothyroid 0.33 ± 0.01 ng/ml, and hyperthyroid 5.15 ± 1.81 ng/ml. The levels of T_3 parallel the thyroxine (T_4) concentration in the sera of these subjects. The correlation coefficient was +0.84 despite the inclusion of five subjects with hypertriiodothyroninemia. A few puzzling conditions elucidated by the application of the T_3 assay are as follows: (1) Hypertriiodothyroninemia – Five patients (4.6%) without therapy and ten patients after treatment with ^{131}I for Graves' disease were hyperthyroid with raised T_3 and normal levels of total T_4 and free T_4. Another four patients developed overt hyperthyroidism, followed with increased T_4. (2) Euthyroidism with low T_4 – Three patients, one after treatment with ^{131}I and the others without therapy were considered eumetabolic with normal level of T_3, decreased T_4 and increased TSH. (3) Euthyroidism with low T_3 – Three patients, one after treatment with ^{131}I and the others without therapy were considered eumetabolic with normal levels of T_4 and TSH, and decreased T_3. All conditions were found in patients after treatment with ^{131}I for Graves' disease. Condition (2) is probably attributed to TSH hypersecretion which may result in T_3 release about twice as much as that of T_4. But in condition (3), TSH concentration was within normal range. These two conditions are considered as preclinical hypothyroidism. (auth)

33661 COMPARISON BETWEEN ^{57}Co-BLEOMYCIN, ^{99m}Tc-BLEOMYCIN, AND ^{111}In-BLEOMYCIN AS THE TUMOR SCANNING AGENTS. Hisada, K.; Suzuki, Y.; Hiraki, T.; Ando, I. (Kanazawa Univ. (Japan). School of Medicine); Ando, A. Radioisotopes (Tokyo); 23: No. 1, 53-58(Jan 1974). (In Japanese).

The tumor affinity of ^{57}Co-bleomycin, ^{99m}Tc-bleomycin, and ^{111}In-bleomycin was examined by using Yoshida sarcoma-bearing rats, and inflammation affinity of these compounds was also tested by rats with inflammation induced by croton oil injection. In our experiments, ^{57}Co-bleomycin had excellent biological characteristics as the tumor scanning agent, but ^{99m}Tc-bleomycin and ^{111}In-bleomycin showed poor results compared to ^{57}Co-bleomycin as the tumor scanning agent. All compounds were rapidly excreted in the urine. But retention values of ^{99m}Tc-bleomycin and ^{111}In-bleomycin were more similar to those of $^{99m}TcO_4^-$ and ^{111}In-citrate than those of ^{57}Co-bleomycin. All compounds had relatively strong affinity to the inflammation tissue. Half a millicurie of ^{57}Co-bleomycin was injected intravenously to twenty-three patients with a variety of known malignancies and scintiphotos were obtained at six and twenty-four hours after injection. Two to three millicuries of ^{99m}Tc-bleomycin were injected intravenously to six patients in these twenty-three patients and scintiphoto were obtained at thirty and sixty minutes after injection. In the case of ^{57}Co-bleomycin, tumors were positively delineated in fifteen of twenty-three cases, but tumors were not positively delineated in patients administered ^{99m}Tc-bleomycin. (auth)

33662 THE USE AND MEASURING CONDITION OF THYOPAC-4 AND THE CORRELATION BETWEEN THIS METHOD AND RES-O-MAT T_4 ETC. Katayama, M.; Hasegawa, T.; Asano, H.; Arakawa, T. (Kawasaki City Hospital, Kanagawa (Japan)). Radioisotopes (Tokyo); 22: No. 12, 701-706(Dec 1973). (In Japanese).

Basic and clinical studies of the Thyopac 4 method, which is a simple method of measuring thyroxine (T_4) in the blood, are reported. The procedure of Thyopac 4 was easier than that of Res-O-Mat T_4 and Tetrasorb T_4 method, and an automatic counter was available to this method. Stable values were obtained after about 30 to 40 min of incubation time at about 23°C. Concerning variation of the measurement values σ was ±12.3%. Normal values ranged from 4.7 to 12.9 μg/dl. These values were compared with Res-O-Mat T_4 values, thyroidal uptake of ^{131}I, and Thyopac 3 values measured at the same time. The correlation and the clinical value were as follows: Thyopac 4 value was well correlated with Res-O-Mat T_4 value and Thyopac 4/Res-O-Mat $T_4 = 0.938 \pm 0.02$ with the correlation rate of 89.3%. Thyopac 4 value was also well correlated with the 24-hour thyroidal uptake of ^{131}I with the correlation rate of 82.7%. In the correlation between Thyopac 4 value and Thyopac 3 value Katayama line was determined, of which upper line was $\theta = < 35°$, and lower line was $u = < 11°18'$. Various diseases were divided by these lines. When we assume Thyopac 4/Thyopac 3 = Thyopac FTI value, the correlation between Thyopac 4 value and Thyopac FTI value was significant with the correlation rate of 94.0%, and the correlation between Thyopac FTI value and the 24-hour thyroidal uptake of ^{131}I was also significant with the correlation rate of 84.2%. As described above, the measurement of thyroxine in the blood by Thyopac 4 was very simple and valuable from both basical and clinical points of view. (auth)

33663 APPLICATION OF MICROSPHERE METHOD. Theory and Valuation. Ito, M. (Tokyo Metropolitan Geriatric Medical Center (Japan)). Kokyu To Junkan; 22: No. 7-8, 583-588(Aug 1974). (In Japanese).

In this review the method to distribute local circulation by labeled particles, which is called particle distribution method, and its clinical application were investigated. Macro Aggregated Albumin (MAA), Albumin Microsphere (AMS) and carbonized microsphere are used as labeled particles. The investigator uses these labeled particles respectively and examines specific distribution and application of these labeled particles, except microsphere-sized particles and the particle distribution method. Furthermore a comparison of microsphere method and other measurement method of blood circulation by using radioisotope is also mentioned. (JA)

33664 RECEPTOR ASSAY. Matsuzaki, S. (Tokyo Univ. (Japan). Faculty of Medicine). Rinsho Kagaku; 10: No. 9, 1077-1084(Sep 1974). (In Japanese).

A radioreceptor assay (RRA) is described with reference to measurements of insulin, GH, and prolactin which is utilized most frequently. The systems of RRA were summarized in the table, and the labelling methods were briefly outlined. The RRA was superior to RIA on the point that RRA was the method directly connected with the biological action of hormones or other biologically active substances, and some experimental evidences were mentioned. It was known to be possible to search and predict the substances which have similar biological action to a certain already established RRA system, or its antagonistic agents. The number of binding sites and binding affinity varied

one substance to another, their physiological changes were studied by Friesen. There had been some studies on the correlation between physiological changes of the number of binding sites and binding affinity, and pathology. The relationship between the configuration of ACTH and binding were discussed precisely in Osawa's paper, but the mechanism of binding and its relation to the manifestation of hormonal action remained to be solved. (JA)

33665 RADIOAUTOGRAPHIC EXAMINATION OF LOCALIZATION OF BLEOMYCIN IN CELLS. Fujimoto, J.; Azuma, H.; Noguchi, S.; Takai, S. (Osaka Univ. (Japan). Faculty of Medicine). Igaku No Ayumi; 89: No. 8, 451-452(May 1974). (In Japanese).

Intracellular localization of bleomycin (BLM) in mouse ascites tumors was examined radioautographically. After 37mg/kg of ^{14}C-BLM was administered to mice with cancer intraperitoneally, ascites were extracted with time and examined radioautographically. Four hours after the administration, almost all of the ^{14}C-BLM which was incorporated in cells was distributed in nuclear membrane, and 8 hours later, a rapid increase of necrotic cells was observed. Considering that DNA chains are connected to the nuclear membrane, these findings lead to the assumption that the localized bleomycin in cells may be related to the mechanism for producing DNA degradation. (auth)

33666 THE MORPHINE 3-GLUCURONIDE DIRECTED ANTIBODY. Its Immunological Specificity and Possible Use For Radioimmunoassay of Morphine in Urine. Koida, M.; Takahashi, M.; Kaneto, H. (Nagasaki Univ. (Japan). Faculty of Pharmaceutical Sciences). Jap. J. Pharmacol.; 24: No. 5, 707-714 (Oct 1974).

The major metabolite of morphine in human urine, morphine 3-glucuronide, was conjugated to bovine serum albumin by action of a water soluble cardiimide. Immunization of rabbits with the conjugate produced the antibody which effectively bound ^{14}C-labeled morphine. By comparing the potency of various morphine-related compounds to inhibit the binding, the specificity of the antibody was characterized. The ranking in the order to decreasing affinities to the antibody was codeine or morphine 3-glucuronide, morphine, codeine 6-glucuronide, dihydrocodine, morphine 6-glucuronide, and nalorphine. The results indicated that the hapten structure was correctly reflected in the specificity, except that recognition of the glucuronyl moiety by the antibody was not as sharp as had been expected. When the antibody was used for radioimmunoassay of urine sample, the urinary excretion patterns of morphine and codeine in rats could be followed easily for more than 5 days after the drug administration. In addition, experiments were carried out to estimate the excretion patterns of dextromethorphan and dihydrocodeine in humans. Based on the results, it is suggested that the morphine 3-glucuronide directed antibody can be utilized for radioimmunoassay of morphine and its 3-glucuronide in urine. (auth)

33667 FATE OF ^{3}H-LABELED MANNAN IN VIVO. II. Immunologic Identification of Mannan in Tissues. Hojo, H.; Uchiyama, M. (Tohoku Univ., Sendai (Japan)). Yakugaku Zasshi; 94: No. 11, 1425-1428(Nov 1974). (In Japanese).

The structural integrity of radioactive substances in various tissues of mouse recovered after the administration of labeled baker's yeast mannan was examined by the immunological method. Antiserum was prepared from rabbits immunized with the heat-killed whole cells of Saccharomyces cerevisiae. The agglutinin titer of the antiserum was in the range of 1 : 1280 to 1 : 2560 against the living cells of S. cerevisiae. Upon quantitative analysis of the precipitin reaction of ^{3}H-labeled mannan with the antiserum, 50% of the radioactivity was precipitated in the case of antibody excess and equivalence zone. The radioactive substances in the reticuloendothelial tissues of the mouse after injection of ^{3}H- or ^{14}C-mannan had a precipitability similar to mannan for 1 week, and the activity decreased progressively, but disappeared rapidly from the kidney. (auth)

33668 RENAL SCINTIGRAPHY WITH ^{99m}Tc-PENICILLAMIN ACETAZOLAMIDE COMPLEX (TPAC), 2 NEW RENAL SCANNING AGENT. Miki, M.; Machida, T.; Ohishi, Y.; Ueda, M.; Kido, A. (Jikei Univ., Tokyo (Japan). School of Medicine). Rinsho Hinyokika; 28: No. 11, 797-802(Oct 1974). (In Japanese).

Mercury-203- or ^{197}Hg-chlormerodrin is the most popular agent for renal scanning but the hazard is its exposure of the patient to a rather large dose of radioactivity. The recent popularization of scintillation cameras has attracted the interest towards ^{99m}Tc-labelled substances which led to the development of ^{99m}Tc-penicillamin acetazolamide complex (TPAC) by Halperon in 1972. The superiority of this substance is that of excellent scanning image of the kidney, obtaining good renal image even by damaged renal function and minimum exposure to radioactivity. Some clinical experiences using TPAC on 30 cases with renal disease are reported. The TPAC was prepared by the Halperon method and a scintillation camera. (Nuclear Chicago Pho/Gamma HP) was used. Sequential scintiphotography was done right after the intravenous administration of 4 to 8 mCi of TPAC to adults, and imaging was done every 10 minutes for 60 minutes, starting 10 minutes after the administration. The results were compared to other examinations and surgical findings. Renal image was good in spite of renal damage, vascular image and functional image of the kidney could be obtained by TPAC only and was confirmed to be useful for differential diagnosis of space occupying lesion. The excellent renal scanning agent is complicated to prepare, which must be considered from here on. (auth)

33669 AUTORADIOGRAPHIC STUDIES ON THE DISTRIBUTION OF QUATERNARY AMMONIUM COMPOUNDS. III. Distribution, Excretion, and Metabolism of ^{14}C-Labeled Pancuronium Bromide in Rats. Shindo, H.; Nakajima, E.; Miyakoshi, N.; Shigehara, E. (Sankyo Co. Ltd., Tokyo (Japan). Central Research Lab.). Chem. Pharm. Bull. (Tokyo); 22: No. 11, 2502-2510(Nov 1974).

The distribution, excretion, and metabolism of ^{14}C-labeled pancuronium bromide following intraperitoneal administration to rats were investigated by means of wholebody autoradiography and radioassay. The distribution of dimethyl-d-tubocurarine-^{14}C iodide was also investigated in mice for comparison. Pancuronium-^{14}C bromide was found to be accumulated rapidly in the liver, kidney, and cartilage tissues such as the sternum, vertebra, and trachea and slowly in the bone marrow and spleen, while no accumulation was observed in the muscular tissues and central nervous system. The accumulation in the liver continued for a long period and almost disappeared after 30 days survival. Counting of the liver radioactivity revealed that approximately 8, 2.5, 1.2, and 0.5% of the dose remained in the liver after 1, 6, 20, and 30 days, respectively; the concentration decreased with half-life of about 11.2 days after an initial decline with half-life of about 1.2 days. It was confirmed that pancuronium bromide is excreted mainly via urine, mostly in the unchanged form. Dimethyl-d-tubocurarine-^{14}C iodide showed a distribution pattern similar to that of pancuronium-^{14}C bromide. The distribution pattern of pancuronium ion was thus quite similar to that of decamethonium ion, except that the latter accumulates in the muscular tissues. This is considered to be related to the fact that decamethonium is a depolarizer at the neuromuscular junctions, while both pancuronium and d-tubocurarine is a competitive depressant. It was also indicated that the extent of accumulation of bis-onium structure in the liver is determined not by the lipophilic character of the molecule, but primarily by the distance separating the two quaternary nitrogens. (auth)

33670 STUDIES ON THE LIVER SCINTIGRAM OF DRUG-INDUCED HEPATITIS. Tatsuno, I. (National Hospital of Kanazawa (Japan)). Iryo; 28: No. 7, 545-548(Jul 1974). (In Japanese).

Recently, drug-induced hepatitis is being widely noticed. We have experienced nine (4.9%) cases of drug-induced hepatitis in 182 cases of liver scans during six months since December 1971. Liver scan was performed with about 200 μCi of ^{198}Au-colloid. The induced drugs of these nine cases were INAH, PAS, Ethambutol, Rifampicin, Ilosone, Lincocin, Ajmaline, and Honvan. On the sex distribution, these nine cases were all male. All scans showed hepatomegaly in which two cases of right lobe and seven cases of both lobes were included. The space-occupying lesion and the spleen were not seen in all cases. The time of the improvement of the scintigraphic pattern was later than the improvement of liver function, particularly transaminase. The liver scan of drug-induced hepatitis is important to the diagnosis and the development of the disease. (auth)

33671 ANALYTICAL STUDY ON HEPATOCYTE KINETICS BY MEANS OF DNA CYTOFLUOROMETRY IN COMBINATION WITH ^{3}H-TDR AUTORADIOGRAPHY. Ashihara, T.; Takeoka, O.; Kitamura, T.; Hattori, T.; Fukuda, M. (Kyoto Prefectural Univ. of Medicine (Japan)). Kyoto Furitsu Ika Daigaku Zasshi; 83: No. 5, 271-275(May 1974).

Combination of ^{3}H-thymidine autoradiography and DNA cytofluorometry enables us to measure absolute length of S-phase in a cell population, with a single sampling. Proliferating cells in the rat liver 74 h after hepatectomy are studied by this method and the S-phase is estimated at 5.4 h and 6.0 h for diploid and tetrapoid cell classes, respectively. If the object is a homogeneous and asynchronous population, complete cell cycle time analysis can be performed on this single sample. (auth)

33672 STUDIES ON THE UPTAKE OF ^{125}I-LABELLED HCG IN RAT ORGANS USING RADIOAUTOGRAPHY. Tanizawa, O.; Kobayashi, Y.; Fukada, N.; Ueda, G.; Kurachi, K. (Osaka Univ.

(Japan). Faculty of Medicine). Med. J. Osaka Univ. (Engl. Ed.); 24: No. 3, 129-139(Dec 1973).

In order to clarify the correlations between human chorionic gonadotropin (HCG) and rat organs, ^{125}I-labeled HCG and ^{131}I-labeled human serum albumin were administered to rats by using paired labeled technic, and distribution ratio of the labeled compounds in various organs 2 hrs after administration were investigated. As the result, distribution ratio of ^{125}I-HCG was found to be higher than albumin in such organs as ovary, liver, and kidney. When cold HCG was added to ^{125}I-HCG, distribution ratio in liver, kidney, etc. did not change but in the organs such as ovary or adrenal which produce steroid hormone, distribution ratio of ^{125}I-HCG remarkably decreased. Next, localization of ^{125}I-HCG was investigated histologically by autoradiography and it was found that in rat ovary, grains concentrated in theca cell layer and interstitial gland but no uptake of grains was observed in granulosa cells or in primordial follicle. In the kidney, grains concentrate on the proximal tubule. In the liver, some grains were noticed in sinusoid. The receptor site of HCG can not be determined from the aforesaid results only, but in the light of the results of competition between cold HCG, it was suggested that the receptor site of HCG exists in rat ovary and its site is most possibly in theca cell and interstitial gland. (auth)

33673 MEASUREMENT OF REGIONAL HEPATIC BLOOD FLOW BY THE INTRAPARENCHYMAL XENON TECHNIQUE. Nakao, N. (Kobe Univ. (Japan). School of Medicine). Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 5, 302-315(May 1974). (In Japanese).

Hepatic blood flow has been assessed with ^{133}Xe dissolved in saline solution by hepatic artery and portal vein catheterization during laparotomy. No attempt has been made to do it by a less traumatic approach. This report describes hepatic blood flow measurement using percutaneous ^{133}Xe injection into the liver in adult mongrel dogs and in patients with various liver diseases. Xenon-133 clearance curve was recorded in narrow cylindrical collimators connected to a 400 channel multiscaler. Multicompartmental analyses were applied to the data using both the manual graphic method and the newly developed computer method designated as "Multistep digital simulation". The following results were obtained: the regional hepatic blood flow with ^{133}Xe injected into the liver parenchyma was much slower than that with ^{133}Xe injected into the hepatic artery, while the highest flow was obtained when the isotope was injected into the portal vein; there was an excellent correlation between the regional hepatic blood flow with ^{133}Xe injected into the liver parenchyma and that with ^{133}Xe injected into the portal vein ($r = 0.74$, $p < 0.01$); the mean regional hepatic blood flow by the intraparenchymal xenon technique in various liver diseases were as follows: Normal, 68 ± 14.4 ml/100 g/min (Mean ± S.D.); Acute hepatitis, 66 ± 14.7 ml; Chr. hepatitis, 53 ± 5.3 ml; Liver cirrhosis, 49 ± 7.8 ml; and ^{133}Xe clearance curve would be considered to be made up of three components: The fast (1st) component the greater part of portal flow, the slow (2nd) component the hepatic arterial flow, and the slowest (3rd) component the background. (auth)

33674 INTRARENAL DISTRIBUTION OF BLOOD FLOW IN THE HYDRONEPHROTIC KIDNEY. Kishimoto, T.; Funai, K.; Sasaki, S.; Matsumura, T.; Nakanishi, J. (Osaka City Univ. (Japan). Faculty of Medicine). Nippon Hinyokika Gakkai Zasshi; 65: No. 5, 273-284(May 1974). (In Japanese).

The intrarenal distribution of blood flow measured by the ^{133}Xe washout method was determined in eight patients with hydronephrosis and eight patients with normal kidney. None of the patients had evidence of systemic disease or cardiovascular disease. In the eight hydronephrotic kidneys, the average total renal blood flow was significantly lower than that in the normal kidneys ($P < 0.01$). Cortical blood flow decreased significantly ($P < 0.001$) but juxtamedullary blood flow was relatively well maintained in the hydronephrotic kidneys. The degree of reduced total renal blood flow and the redistribution of renal blood flow from the outer to the inner cortex were proportional to the degree of hydronephrosis estimated by intravenous pyelography, abdominal aortography, and renogram. In three cases of hydronephrosis, ^{133}Xe washout was done before and after treatment. Total renal blood flow increased and redistribution of blood flow was recovered after treatment. The measurement of renal blood flow and its distribution in hydronephrosis by the ^{133}Xe washout method is considered to be a useful check for kidney function. It is compatible with quantitative estimation of kidney function in hydronephrosis. (auth)

33675 EFFECT OF MIXED HYDROGENATED ERGOT ALKALOIDS ON CEREBRAL CIRCULATION. ^{133}Xe Clearance Study in Man. Handa, J.; Matsuda, M.; Ohtsubo, K.; Handa, H. (Kyoto Univ. (Japan). Faculty of Medicine). No To Shinkei; 26: No. 5, 557-561(May 1974). (In Japanese).

Cerebral blood flow (CBF) was measured in 16 patients with cerebrovascular disease or posttraumatic complaints using the ^{133}Xe intracarotid injection technique. After control measurements were performed, 0.005 to 0.006 mg/kg of Hydergine was administered intravenously (5 patients). The mean CBF did not change significantly: mean figures were 38 ml/100 g/min before the administration, and 38 and 36 to 37 ml/100 g/min immediately after and 15 minutes after administration, respectively. In eight patients, a 0.020 to 0.024 mg/kg dose was given. The CBF increased from 41 ml/100 g/min in the steady state to 45 to 46 ml/100 g/min immediately after and 15 minutes after intravenous Hydergine injection, these changes were statistically significant. In the remaining three patients, Hydergine was given in combination with intramuscular dose of ethylphenylephrine hydrochloride. It is concluded that the intravenous Hydergine in doses of 0.020 to 0.024 mg/kg increases the CBF significantly. (auth)

33676 A STUDY ON CSF DYNAMICS OF THE MICROCEPHALY. Radioisotope Cisternography and Radioisotope Ventricular Clearance. Beppu, T.; Matsumori, K.; Takeyama, E.; Baba, M.; Okubo, T. (Tokyo Women's Medical Coll. (Japan)). No To Shinkei; 26: No. 5, 567-579(May 1974). (In Japanese).

The purpose of this paper is to evaluate the radioisotopes (RI) cisternography and RI ventricular clearance in the study of cerebrospinal fluid (CSF) flow in microcephaly. In 21 of 37 cases, RI cisternography were performed and remarkable malabsorption was showed in only three cases, and the reflux into the lateral ventricles was recognized in only four cases. However, abnormal asymmetric cisternograms were detected in 10 cases (consisted of 9 secondary microcephalies and one genetic microcephaly), and pathologic findings were a localized increased RI concentration in some cases and a decreased RI concentration in other cases. The correlation between an asymmetric RI concentration in cisternography and an asymmetric abnormal finding in pneumoencephalogram was not recognized. The examination of RI (^{169}Yb-DTPA) ventricular clearance was carried out in 12 microcephalies (five genetic and seven secondary types). In seven secondary microcephalies out of 12 microcephalies, half time revealed more than 25 minutes without exception, it was exactly distinguishable from the normal levels and involved five delayed CSF flows which were showed in slower levels than 50 minutes of the half time. In the remaining five genetic microcephalies, the half time revealed less than 25 minutes. The half time of ventricular clearance curve was not found to relate to the circumference of the head, Evans ratio, and CSF pressure. Therefore, radioisotope ventricular clearance seemed to be suitable as the detector for the CSF dynamics, which means CSF circulation is mainly from the choroid plexus to the subarachnoid space and ventricular CSF diffusion. The abnormal asymmetric findings of RI cisternography and the measurement of RI ventricular clearance supplied available information for the disturbance of CSF dynamics in microcephaly. Therefore these procedures can be said to be a useful parameter to classify the type of microcephaly. (auth)

33677 EFFECT OF UROKINASE ON THE TUMOR BLOOD FLOW STUDIED BY XENON-133 METHOD. Ogawa, S.; Tsuya, A.; Sugawara, T.; Kawai, T.; Uchida, M. (National Cancer Center, Tokyo (Japan). Hospital). Nippon Gan Chiryo Gakkai-Shi; 4: No. 2, 122-129(Jun 1974). (In Japanese).

The effect of urokinase on the tumor regional blood flow, administered by intraarterial infusion, was studied by ^{133}Xe method. The clearance rate was compared before and immediately after the injection of a single dose of 5,000 Unit of urokinase, dissolved in 10 ml of saline, given slowly at about an hour. Higher clearance rate of ^{133}Xe was observed in eight cases out of 11, which indicated the increased tumor blood flow. On the contrary, no change in the ^{133}Xe clearance rate was seen in the control in which only saline of 10 ml was administered. The concomitant use of urokinase for intraarterial chemotherapy is commended for cases, in which the poor response to the chemotherapeutic agents is suspected. (auth)

33678 CORRELATION BETWEEN BLOOD RETENTION RATES OF ^{131}I-BSP AND ICG STUDIED FROM DYNAMIC HEPATIC RI ACCUMULATION. Suematsu, T.; Nishimura, T.; Kashiwagi, T.; Kamada, T.; Abe, H. (Osaka Univ. (Japan). Faculty of Medicine). Kanzo; 15: No. 6, 353-361(Jun 1974). (In Japanese).

Using the medical radioisotopic data-analyzing apparatus, dynamic hepatic RI accumulation or elimination curves and/or dynamic blood clearance curves following the intravenous injection of ^{198}Au-colloid or ^{131}I-Bromosulphalein (BSP) were obtained to analyze the dynamic and quantitative information concerning liver function activities. After simulation analysis of the curves, the results obtained were as follows: the cal-

culated rate constants from blood to liver in healthy, chronic hepatitis, and cirrhotic subjects were 0.084, 0.060, and 0.033 respectively; and the blood retention rate (BRR) of ^{131}I-BSP at 10 min. after the injection was considered to be a useful index of ^{131}I-BSP uptake in liver. The correlation of the BRR of ^{131}I-BSP at 10 min. with that of indocyanogreen (ICG) at 15 min. was calculated to be 0.78. However, the BRRs of ^{131}I-BSP at 30 min. and ICG at 15 min. were correlated relatively low ($R = 0.40$). From these results, the BRR of ^{131}I-BSP at 30 min. was considered to be a different information of liver function activity to the BRR of ICG at 15 min. The hepatosplenic RI accumulation curves, moreover, obtained from the interested areas above right and left lobes of liver and spleen were generally reflected the change of the liver circulation in liver diseases and it was also suggested that the analysis of hepatosplenic RI accumulation curves have some practical purposes of diagnosis. (auth)

33679 RADIOISOTOPE PULMONARY SCANNING IN THE PULMONARY VASCULAR BED ALTERATIONS. Joseph Chang, C. H. (Kansas Univ., Kansas City (USA). Medical Center). Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 8, 580-589(Aug 1974).

Radioisotope lung scanning was performed in patients with known pulmonary vascular bed alterations including 17 bituminous coal miners with chronic obstructive lung disease, four cases of atrial septal defects with reverse shunts (Eisenmenger's reaction), and two patients of mitral stenosis having severe pulmonary hypertension. Scintigraphic abnormalities consisting of increased width of peripheral hypoperfusion areas, irregular zones of decreased activity around the circumference of the lung causing the lobe or lungs to appear shrunken (shrunken lobe or lung sign) or fissure sign were demonstrated in all our cases with known microvascular bed change of the lung from various causes. Radioisotope pulmonary scanning is not only useful in the diagnosis of gross pulmonary perfusion abnormalities but it is also feasible to assess the pulmonary microvascular bed alterations. With improvement of radioactive scanning materials and instrumentations, the diagnosis of early changes in pulmonary microvascular bed may be possible and this will tremendously assist in the management of the patient. (auth)

33680 A CLINICAL STUDY WITH ^{99m}Tc-Sn-DTPA DYNAMIC RENOSCINTIPHOTOGRAPHY AND RENOGRAPHY USING SCINTILLATION CAMERA. Miyamae, T.; Tsubogo, Y. (Saitama Medical School, Moroyama (Japan)). Radioisotopes (Tokyo); 23: No. 10, 563-569(Oct 1974). (In Japanese).

Thirty-one dynamic renoscintiphotographs and renograms, using instantly prepared ^{99m}Tc-Sn-DTPA (by Daiichi Radioisotope Labs., Ltd.), were obtained from 27 patients with various renal diseases. Simultaneously, 17 of 27 patients underwent renography using sodium iodohippurate (^{131}I), and the results were compared with those of ^{99m}Tc-Sn-DTPA. In ^{99m}Tc-Sn-DTPA, fast and slow dynamic study such as scintiphotographs of vascular phase and functional phase, and renogram, can be performed using only one kind of nuclide. Especially, this nuclide is effective in the diagnosis of renal tumor. The curve of renogram by ^{99m}Tc-Sn-DTPA is more gentle and tends to have a delayed peak time compared with that by sodium hippurate (^{131}I), on this curve yet the evaluation of renal function can be done satisfactorily. Furthermore its application to regional renogram is considered to be possible. Evaluation of renal function of serious cases is difficult, however. In such a case, evaluation of renal function by the image, which is used to be given through scintillation camera, will become important. Renal studies with ^{99m}Tc-Sn-DTPA didn't produce any side effects. (auth)

33681 LIVER SCINTIGRAPHY AND LIVER BLOOD FLOW INDEX K_L USING ^{99m}Tc-COMPOUNDS (^{99m}Tc-Sn-PHYTATE AND ^{99m}Tc-Sn-COLLOID) FOR THE DIAGNOSTIC EVALUATION OF DIFFUSE LIVER DISEASE. A Comparison of ^{198}Au-Colloid and ^{99m}Tc-Compounds. Miyamae, T. (Saitama Medical School, Moroyama (Japan)). Radioisotopes (Tokyo); 23: No. 10, 570-575(Oct 1974). (In Japanese).

In order to investigate the diagnostic possibility of diffuse liver disease by ^{99m}Tc-Sn-phytate (produced by Daiichi Radioisotope Labs., Ltd.), ^{99m}Tc-Sn-colloid (electrolysis, Dainabot Radioisotope Labs., Ltd.), and by ^{99m}Tc-Sn-colloid (Daiichi Radioisotope Labs., Ltd.), ^{198}Au-colloid and the above three kinds of ^{99m}Tc-compounds were administered respectively to 68 cases including 32 with diffuse liver disease and 36 others, and the scintigrams and liver blood flow index (K_L) values obtained therefrom were compared reciprocally. In the examination, the scintigram obtained by ^{99m}Tc-Sn-phytate closely resembles that by ^{198}Au-colloid. Moreover, its K_L value was fairly close to that by ^{198}Au-colloid. From those facts it was concluded that ^{99m}Tc-Sn-phytate is useful in the diagnostic evaluation of diffuse liver disease. As for the remaining two kinds of ^{99m}Tc-Sn-colloid, they were not considered to be ideal for the above evaluation due to their excessively high splenic uptake, and fairly high and variable K_L values. They seemed rather to be adequate for the tumor diagnosis or spleen scintigram. When those ^{99m}Tc-compounds were administered, no remarkable secondary effect was detected. It was therefore concluded that they all were quite safe compounds to be handled. (auth)

33682 HEPATOSCINTIGRAPHY USING ^{99m}Tc-Sn-COLLOID PREPARED BY MEANS OF ELECTROLYSIS. Kaneko, M.; Sasaki, T.; Watanabe, M. (Nagoya Univ. (Japan). Hospital); Tomita, T.; Yamamoto, C. Radioisotopes (Tokyo); 23: No. 10, 576-581(Oct 1974). (In Japanese).

The apparatus for electrolysis was obtained from Dainabot Radioisotope Laboratory. Three hundred and sixteen cases of various kinds of liver disease such as hepatoma, metastatic liver cancer, liver cirrhosis, and hepatitis were subjected to study, and 335 examinations were done in 10 months. In all cases, the examinations were successful in demonstrating liver and spleen for the evaluation of size, shape, and the existence of filling defects. Bone marrow was also observed in some cases. Apart from such reticulo-endotherial system (RES) organs, the kidneys were observed on the scintiphotos on several examinations. According to the chronological sequence of study, these examinations were divided into six groups. In cases of group I, the kidneys appeared in 15 out of 23 cases; while in group II, eight out of 39 cases, however, in none of 18 when we used counter-electrolysis after normal electrolysis; in group III, seven out of 41; in group IV, 15 out of 34, including seven instances of second use of the same vials; in group V, only one out of 42 and in group VI, seven out of 156. In sum up of V and VI groups, eight out of 198 (4%). Paper electrophoretic study indicated that the presence of the technetium compound having plus ion might play some role in the mechanism of renal uptake. This substance was cleared in the course of time, and also by the counter-electrolysis. In conclusion, the preparation of technetium-Sn-colloid by this kind of electrolysis apparatus of these days was found useful for the demonstration of RES organs, if each vial was used once only. (auth)

33683 STUDIES ON THE LIVER SCANNING WITH NEW RADIOPHARMACEUTICALS, ^{99m}Tc-Sn-COLLOID AND ^{99m}Tc-PHYTATE. Tatsuno, I.; Michigishi, T.; Kato, S. (National Hospital of Kanazawa (Japan)). Radioisotopes (Tokyo); 23: No. 11, 620-627(Nov 1974). (In Japanese).

Fundamental and clinical investigation on the liver scanning were carried out with ^{99m}Tc-Sn-colloid (^{99m}Tc-Sn-C) and ^{99m}Tc-phytate (^{99m}Tc-P), both of which were made into kits by Daiichi Radioisotope Labs., Ltd. for the non-electrolytic method. In the preparing point of view, ^{99m}Tc-P seems to be prepared more easily and is more stable than ^{99m}Tc-Sn-C. The labelling yields of both agents were about 99% and, also their particle sizes were uniform. In the liver scintigrams, any remarkable differences between both agents were not observed in shape, size, and RI distribution of the liver, and any background images disturbing the reading of the scintigrams were not observed. The splenic image with ^{99m}Tc-Sn-C was more clearly delineated than that with ^{99m}Tc-P. Generally, the RI ratio of spleen vs. liver (right lobe) (Sp/R) with ^{99m}Tc-Sn-C was greater than that with ^{99m}Tc-P irrespective of each group of liver diseases. Especially, in the liver cirrhosis, Sp/R ratio was remarkably high, and this fact is very important for its scan diagnosis. In the liver scintigrams, the degree of splenic visualization with ^{99m}Tc-P being quite similar to that with ^{198}Au-colloid, the scintigram with ^{99m}Tc-P seems convenient as diagnostic criteria. In the point of correct diagnosis of liver cirrhosis, ^{99m}Tc-Sn-C was superior to ^{99m}Tc-P. Liver scintigrams obtained with ^{99m}Tc-Sn-C and ^{99m}Tc-P respectively are useful for the differential diagnosis of the upper abdominal masses, observation of therapeutic course of various liver diseases, decision on the existence of operative indication and its method. No side effects were observed in both agents, ^{99m}Tc-Sn-C and ^{99m}Tc-P. We came to a conclusion that both ^{99m}Tc-Sn-C and ^{99m}Tc-P are effective scanning agents, giving scintigrams of excellent quality with very little internal radiation exposure and fairly simple kit operation. (auth)

33684 THE STUDIES OF LIVER FUNCTION TEST BY UPTAKE OF RADIOACTIVE DIAGNOSTIC AGENTS IN CARBON TETRACHLORIDE FATTY LIVER. Kuboders, A. (Science Univ. of Tokyo (Japan). Faculty of Pharmaceutical Sciences); Tsurufuji, S. Radioisotopes (Tokyo); 23: No. 11, 628-634(Nov 1974). (In Japanese).

In the present experiments, radioactive rose bengal and radiogold colloid were used as radioactive diagnostic agents to determine the mechanism of liver damages caused by CCl_4, and with the purpose of screening of the drugs functionally alleviating liver damage caused by CCl_4. Rats were used as the experi-

mental animals. The determination of liver uptake ratio of radioactive rose bengal in the liver, the changes of liver uptake of radioactive rose bengal and radiogold colloid among the animal groups treated by CCl_4, the uptake fluctuations when treated by the different levels of curies and specific activities were included in this study. The liver uptake of radioactive rose bengal was significantly lower in the groups treated with CCl_4 than that in control. A decrease in the uptake was proportional to the doses of CCl_4, but was not correlated with the changes of hepatic blood flow. The administration of CCl_4 in the low doses which caused no remarkable histological changes induced a decrease in liver uptake of radioactive rose bengal. Since the values of serum transminase were comparable with that of control at the levels, the liver function seemed to be highly sensitive to the uptake of radioactive rose bengal. (auth)

33685 ^{131}I-MAA LUNG SCANS PROCESSED BY THE ELECTRONIC COMPUTER. Machida, K.; Yasukochi, H.; Ohshima, M.; Uno, K. (Tokyo Univ. (Japan). Faculty of Medicine). Radioisotopes (Tokyo); 23: No. 11, 635-639(Nov 1974). (In Japanese).

As previously reported, we record lung scans on paper tapes with the routine scintigrams simultaneously. By using these tapes we processed the scintigrams with a TOSBAC 40 TIME SHARING SYSTEM electronic computer. The anterior and posterior scintigrams were recorded with the Toshiba scintiscanner (ϕ : 3 in) with the 37 hole collimator (the distance of focus: 10 cm), after intravenous administration of ^{131}I-MAA to the sitting patient. The quality of the images was compared with the original scintigram, the non-smoothed digital printed by the computer, and the smoothed digital. By smoothing the original, the image of lung scans was improved remarkably and appeared to be useful in clinical use. The computer displayed each point in 10 different marks according to the number of counts, which enabled us to recognize the radioactivity of the points semiquantitatively. Furthermore the integral counts of both lung fields were calculated. The normal anterior values were 43.2 ± 4.9% (N = 10) in the left and 56.8 ± 4.9% in the right; posterior values were 46.7 ± 2.7% (N = 6) in the left and 53.3 ± 2.7 in the right. The ratio of each level of the counts between left and right lung was also compared. All these data were obtained very easily by the computer and expected to be useful clinically. (auth)

33686 ALICYCLIC ACID METABOLISM IN PLANTS. V. Biosynthesis of Alicyclic Acids from ^{14}C-Labeled Glucose and Erythrose in Some Plant Tissues. Tazaki, K.; Minamikawa, T.; Yoshida, S. (Tokyo Metropolitan Univ. (Japan)). Plant Cell Physiol. (Tokyo); 15: No. 2, 205-211(Apr 1974).

Etiolated seedlings of Phaseolus mungo were fed with ^{14}C-glucose and the incorporation of ^{14}C into shikimic and quinic acids was determined. The incorporation of ^{14}C into shikimic acid was enhanced when non-labeled shikimic, quinic, or 5-dehydroquinic acid was supplied to seedlings simultaneously with ^{14}C-glucose, whereas that into quinic acid was not significantly affected by these alicyclic acids. To examine whether the difference in biosynthetic patterns between shikimic and quinic acids is common in higher plants, flowers and leaves of several plants were fed with ^{14}C-glucose or ^{14}C-erythrose and the efficiencies of these labeled sugars as precursors of shikimic and quinic acids were compared. In seven of eight plant samples, erythrose was superior to glucose as the precursor of shikimic acid, while there was no great difference in the efficiency of either sugar as the precursor of quinic acid. The possibility that the biosynthetic mechanism for quinic acid differs from that for shikimic acid is discussed. (auth)

33687 RECENT STATUS OF RADIOPHARMACEUTICALS. Murakami, Y. (Tokyo Metropolitan Univ. (Japan). Faculty of Science). Genshiryoku Kogyo; 20: No. 8, 9-13(Aug 1974). (In Japanese).

The nuclides, dose, and use of radioactive medical supplies were surveyed. The diversity of radioisotopes and the high development of accompanying instruments are described. The use of RI was compared between the world and Japan and new radioisotopes, ^{123}I and ^{18}F, are considered. The urgency of establishment of the production system in Japan was described. The chemical form and problems of labeled compounds were explained. The exploitation of radioactive medical supplies were examined. Lastly, the future trend for the education of radiopharmacists was referred to. (JA)

33688 METABOLIC CONVERSION OF PHOTOSYNTHETIC $^{14}CO_2$ FIXATION PRODUCT AND SUCROSE FORMATION BY THE USE OF MULBERRY LEAF SEGMENTS. Yazawa, M.; Yamashita, T. (Sericultural Experiment Station, Tokyo (Japan)). Nippon Sanshigaku Zasshi; 43: No. 4, 304-310(Aug 1974). (In Japanese).

Formation of sucrose through photosynthetic carbon reduction cycle in mulberry leaves was investigated by feeding $^{14}CO_2$ to leaf segment. Compounds labelled with ^{14}C by $^{14}CO_2$ fixation for a short period (5 seconds) were mainly serine, alanine, glyceric acid, and 3-phosphoglyceric acid (3-PGA). Subsequent to the rapid labelling of these earlier products, the increase of ^{14}C in sucrose was observed. Among the labelled compounds sucrose was the only product which continued to increase in the percentage distribution of ^{14}C. The intramolecular distribution of ^{14}C to carboxyl carbon of alanine and 3-PGA at short period of $^{14}CO_2$ fixation exceeded 75% of ^{14}C in respective compounds, while ^{14}C in carboxyl carbon of serine did not exceed 55% at any periods of time of $^{14}CO_2$ fixation. When $^{14}CO_2$ was removed from air atmosphere after photosynthesis in $^{14}CO_2$ for 2 min, decreasing of ^{14}C in serine during further photosynthesis in $^{12}CO_2$ was remarkable among other ^{14}C products. On the contrary, the distribution of ^{14}C to sucrose was rapidly increased and accounted for 60% of ^{14}C in ^{14}C products at 25 min after removal of $^{14}CO_2$. Treatment of leaf segment with hydroxymethane sulfonate caused marked increase of ^{14}C in sugar phosphate and decrease of ^{14}C distribution in alanine, serine, glyceric acid, and sucrose. These results indicate that sucrose present in higher concentration in mulberry leaves is rapidly synthesized through the photosynthetic carbon reduction cycle which involves the direct participation of serine metabolism. (auth)

33689 EXPERIMENTAL STUDIES WITH ^{125}I-LABELED GAMMA-GLOBULIN ON THE DISTRIBUTION OF ANTIGEN AND ANTIBODY IN ORGANS OF THE RABBIT. Fukuda, A. (Kumamoto Univ. (Japan). School of Medicine). Jibi To Rinsho; 20: No. 3, 428-445(May 1974). (In Japanese).

In order to study the role of γ-globulin, the experiment was attempted. After the last of the series of Bovine γ-globulin (BGG) was injected into the experimental aseptic abscess, the amount of ^{125}I-labeled BGG in organs of the sensitized rabbit was counted. The amount of ^{125}I-extracted γ-globulin from the experimental abscess injected with streptococcus was measured as the method of the sensitized rabbit with BGG. The study of the sensitized rabbit with BGG revealed that the amount of ^{125}I-BGG taken up was the highest in the lung, followed by the spleen, the liver, the tonsil, the kidney, and the heart, in that order. This result showed that the spleen, the liver, the tonsil, and the lung had the higher ability of antibody formation or antibody possession. The antibody level in the above organs was lower following intravenous injection with extracted γ-globulin from the experimental abscess than BGG injection. However, from this observation, the close relationship between BGG and the extracted γ-globulin had the antigenic ability. By means of autoradiography, it was revealed that antigen in tonsil adhered to the surface of the lymphoid cell in the subepithelial area and in the circumference of lymphnodules. In lung, antigen was involved in the fibrinoid degeneration of the thrombosis. In kidney, antigen was seen in the basement membrane and the epithelial cell of the renal tubules. In spleen, antigen adhered to the surface of the small lymphoid cells in the outer zone of the lymphnodules and in the red pulp. These autoradiographic studies showed the part of antibody existence and found the place of the antigen-antibody reaction in the tissue or the cell, specially in tonsil. These findings suggested that the role of γ-globulin had the most important significance for the focal infection. (auth)

33690 AGGLUTINATION OF BACTERIAL SPHEROPLAST. III. Relationship of Labelled Concanavalin A Binding to the Agglutinability. Maruyama, H. B. (Nippon Roche Research Center, Kamakura, Kanagawa). J. Biochem. (Tokyo).; 75: No. 1, 165-170(Jan 1974).

^{63}Ni- and ^{3}H-acetyl labelled concanavalin A's (con A) were found to agglutinate protease-treated spheroplasts of E. coli by about one-third and slightly less than the original con A, respectively. However, both radioactively labelled con A derivatives apparently bound to the spheroplasts in the same manner. The total amount of labelled con A's bound per spheroplast was slightly less with protease-treated spheroplasts than non-treated ones, which were not agglutinated by con A. The number of con A molecules bound per spheroplast was in the range of $6-8 \times 10^5$, approximately one-hundredth of the molecules bound to a transformed mammalian cell, as reported elsewhere. Methyl α-D-glucoside (α MG) showed at most 50% inhibition of con A binding at a concentration sufficient to inhibit agglutination completely. Specific binding of con A molecules to α MG sites was found to be higher with protease-treated spheroplasts ($2.7-3.8 \times 10^5$) than with non-treated ones ($2.2-2.4 \times 10^5$). When incubation was performed at temperatures lower than 37°C, the agglutination was reduced greatly or completely at 0°C, whereas the binding was inhibited by only 20% at most. From these results the relationship between the binding of con A on the spheroplast surface and the inhibition of agglutination was discussed in relation to observations in the transformed animal cell-con A system. (auth)

33691 RADIOIMMUNOASSAY OF PLASMA PROGESTERONE. I. In Case of Normal Menstrual Women. Tateyama, H.; Kajiwara, K.; Murakami, T.; Utsunomiya, T.; Kadota, T. (Kyushu Univ., Beppu, Oita (Japan). Inst. of Balneotherapeutics). Onken Kiyo; 25: No. 4, 213-219(Dec 1973). (In Japanese).

A specific progesterone antiserum was obtained by immunizing a rabbit with progesterone-3-oxime conjugated to bovine serum albumin. The radioimmunoassay of plasma progesterone in 5 normal menstrual women, 5 menstrual cycles was achieved, measuring urinary luteinizing hormone (LH) by Luteonosticon semi-quantitative method to find the day of LH surge. Recovery of ^{3}H-progesterone after ether extraction was 89.85 ± 8.92%. No chromatographic step was allowed for the specific antiserum. Separation of bound from free hormone was used by 50% ammonium sulfate. Mean values of plasma progesterone in follicular and luteal phase were 0.73 ± 0.49, 14.10 ± 4.52 ng/ml. Both composite pattern of BBT and plasma progesterone levels was typical and good agreement with those described by other reporters. A technician can measure over 30 plasma samples in a day, and this method is very useful in clinical purposes. (auth)

33692 ON GLYCOLYSIS IN RAT EGGS DURING PRE-IMPLANTATION STAGES. Sugawara, S.; Takeuchi, S. (Tohoku Univ., Sendai (Japan). Faculty of Agriculture). Tohoku J. Agr. Res.; 24: No. 2, 76-85(Aug 1973).

Experiments were undertaken to determine the metabolic pathway of glucose and pyruvate in the rat embryo during the pre-implantation stages. In the cleaved rat ova before blastocyst, the production of $^{14}CO_2$ from $^{14}C_1$-glucose was far more rapid than that produced from $^{14}C_6$-glucose, suggesting a very active pentose shunt during early cleavage stages. In the blastocyst, the $^{14}C_1$ to $^{14}C_6$ ratio in the $^{14}CO_2$ production from both labelled glucoses was smaller than that of the ova before blastocyst formation. In all stages of the rat embryos, the production of CO_2 from $^{14}C_1$-pyruvate was much greater than that of the labelled glucose. The sum of the CO_2 production from both glucose and pyruvate accounted for 30 percent of the O_2 uptake utilized by the rat ova in all stages. In all rat embryo cases the incorporation of the carbon from both glucoses into the trichloroacetic acid insoluble fraction of the embryo was much greater than that of pyruvate. The roles of both glucose and pyruvate in the energy metabolism of rat embryo during early cleavage stage were discussed. (auth)

33693 EVALUATION OF VERTEBRAL COLUMN SCINTIGRAMS. Seyss, R. Isotopenpraxis; 10: No. 11-12, 423-427 (1974). (In German).

In vertebral column scintigraphy, activity counting is done simultaneously with the color or photoscan and the scintigraph is evaluated using a one-dimensional profile scan. The isotopes ^{85}Sr and ^{99m}Tc are both suitable. In normal subjects, the activity profiles lie within the range of statistical scattering. In abnormalities, the activity is concentrated at that site. Typical x-ray pictures, scans, and activity curves are shown for normal patients and patients with abnormalities. (JSR)

33694 ASSESSMENT OF SOME METHODOLOGICAL ASPECTS OF RADIOIMMUNOASSAY OF TRIIODOTHYRONINE. Galbiati, A.; Malvano, R.; Zucchelli, G. C. (Univ., Pisa, Italy). J. Nucl. Biol. Med.; 18: No. 4, 160-169(1974).

A sensitive, specific, rapid, and reproducible radioimmunoassay for direct measurement of triiodothyronine (T_3) in plasma is described. The assay is based on the use of a T_3-free plasma as a standard diluent and of merthiolate as an inhibitor of plasma proteins interacting with T_3. T_3 levels in euthyroid, hypothyroid, and hyperthyroid subjects were found to average 1.57 ± 0.34 S. D. (range 1.00 to 2.40), 0.57 ± 0.31 S. D. (0.25 to 1.05), and 4.13 ± 1.21 S. D. (2.30 to 8.00) ng/ml, respectively. The results of a study aimed at standardizing and validating the method are reported and discussed. (auth)

33695 DETECTION OF INTRA-ABDOMINAL BLEEDING BY RADIOISOTOPE SCANNING AFTER EXPERIMENTAL EXTRAVASATION. D'Addabbo, A.; Fersini, M. (Univ., Bari, Italy). J. Nucl. Biol. Med.; 18: No. 4, 170-174(1974).

Intra-abdominal bleeding by experimental blood extravasation was detected in dogs by using scanning and body surface counting techniques. Chromium-51-labeled erythrocytes and ^{131}I-labeled albumin were employed as test substances. The procedure, qualitative rather than quantitative, may give useful informations complementing other diagnostic data in the evaluation of unexplained post-traumatic anemias and detection of intra-abdominal bleeding. (auth)

33696 RADIOIMMUNOASSAY FOR MEDROXYPROGESTERONE ACETATE (PROVERA^R) USING THE 11α-HYDROXY SUCCINYL CONJUGATE. Royer, M. E.; Ko, H.; Campbell, J. A.; Murray, H. C.; Evans, J. S.; Kaiser, D. G. (Upjohn Co., Kalamazoo, MI). Steroids; 23: No. 5, 713-730(May 1974).

A radioimmunoassay was developed for medroxyprogesterone acetate (MPA; Provera^R) employing rabbit antibodies made against a bovine serum albumin (BSA) conjugate of the hemisuccinate ester of 11α-hydroxy MPA. The 11α-hydroxyl group was introduced into MPA by a series of chemical and microbiological transformations. The acid succinate MPA derivative was coupled to BSA via reaction with N,N'-carbonyldiimidazole. Cross-reactivities of several MPA analogs were compared using rabbit antisera developed against the C-11 conjugate of MPA and goat antiserum developed against a C-3 conjugate of MPA. Antibodies formed against the C-11 conjugate showed increased specificity to steroid analogs with changes in the C-3, C-5, and C-6 positions but less specificity to changes in the C-21 side chain. The profiles of serum MPA levels vs. time, measured with both the C-3 and C-11 antisera, after oral drug administration to the monkey were similar. After intramuscular drug administration to dogs, serum MPA levels measured with the C-3 antisera were consistently greater as compared to those with the C-11 antisera. Factors affecting precipitation of the antibody-antigen complex, assay precision, and assay sensitivity were evaluated. (auth)

33697 NEW APPROACH TO BREAST CANCER. Breast Uptake of ^{99m}Tc-HEDSPA. Siegel, M. E.; Friedman, B. H.; Wagner, H. N. Jr. (Johns Hopkins Medical Inst., Baltimore). J. Amer. Med. Ass.; 229: No. 13, 1769-1771(23 Sep 1974).

Thirty-three patients with carcinoma of the breast had routine bone scans performed with ^{99m}Tc-labeled 1-hydroxy-ethylidene-1,1-disodium phosphonate. Twenty-four of these patients had increased radioactivity in the clinically normal breast in addition to the abnormal breast, if present. Only 2 of the 17 patients studied who had no carcinoma of the breast had bilateral uptake. Both of these had bilateral fibrocystic disease. No patient with two normal breasts had increased uptake in either breast. Of those patients who had uptake in the clinically normal breast, 93% (24/26) had carcinoma. (auth)

33698 RADIOIMMUNOASSAY: REVIEW OF BASIC PRINCIPLES. Goldsmith, S. J. (Mount Sinai Hospital, New York). Semin. Nucl. Med.; 5: No. 2, 125-152(Apr 1975).

The development of radioimmunoassay by the late Solomon A. Berson and Rosalyn S. Yalow during the late 1950s represents a milestone in the history of the application of radionuclide methodology to biology and to medical investigation and practice. The method offers a technique to assay materials otherwise unmeasurable or detectable only with difficulty. Radioimmunoassay is based upon the competition between labeled and unlabeled antigen for specific antibody sites, forming antigen–antibody complexes. This reaction is described by the expression antigen + specific antibody ⇌ antigen-antibody complex; radioactive antigen + specific antibody ⇌ radioactive antigen-antibody complex. At equilibrium, the radioactive complex (bound) is separated from the radioactive antigen (free). The B/F ratio is dependent upon the amount of nonradioactive antigen. Antigen concentration in unknown samples is determined by comparing the B/F ratio to the B/F ratios obtained by incubating varying amounts of known nonradioactive antigen with the same amount of antibody as in the unknown sample under similar assay conditions. Sensitivity of the order of 10^{-12} moles/liter may be achieved through the preparation and use of a labeled antigen of high specific activity and the production and selection of antisera with appropriately high affinity constants. Specificity is dependent upon the ability of the antiserum to recognize subtle structural features of the antigen molecule. The ability to conveniently assay large numbers of samples with good precision has led to the application of this technique to quantitate substances (such as steroids) already measurable but by more cumbersome methods. Since the initial description of competitive binding radioassay techniques, there have been numerous contributions to its further development, refinement, and application. This article reviews the conception and development of this invaluable contribution to our understanding of health and disease. (auth)

33699 PRECISION OF RADIOIMMUNOASSAY WITH EMPHASIS ON CURVE-FITTING PROCEDURES. Hidalgo, J. U.; Maduell, C. R.; Bloch, T.; Spohrer, L. R.; Wooten, M. (Touro Infirmary, New Orleans). Semin. Nucl. Med.; 5: No. 2, 153-156(Apr 1975).

Direct curve-fitting methods using a digital computer have been employed to analyze the calibration curves of commercial kits for the assay of digoxin, digitoxin, insulin, B_{12}, and renin activity (angiotensin). Inconsistencies have been revealed that suggest some improvements in the commercial kits are desirable. It is not suggested that the use of these kits would yield data of uncertain clinical value, but it is suggested that improvements in consistency would enhance the clinical utility. (auth)

33700 EVALUATION OF COMMERCIAL RADIOIMMUNOASSAY KITS. Kagan, A. (Coney Island Hospital, NY). Semin. Nucl. Med.; 5: No. 2, 173-182(Apr 1975).

By means of kits, RIA and competitive binding assays are beginning to fulfill their great clinical potential. The reliability of these kits is still difficult to assess. The great variety of assayable substances and differing methods prevent any standard approach to kit analysis. Nevertheless there are means of evaluating many features of RIA kits. More important even than the necessary reproducibility of assays are the means of testing for (1) tracer-specific activity, maximal bindability, damage, and free iodine; (2) assay sensitivity; (3) antisera stability, cross-reactivity, ability to measure plasma zero values, ability to accurately measure serial plasma dilutions; and (4) comparability of standard curve slopes from assay to assay. Separation techniques need proper standardization. Correction for incubation damage is recommended. It is necessary to insist on reasonably precise manufacturers' specifications as to antibody specificity and sensitivity. Knowledge of RIA in general and each assay in particular adds to the usefulness of the results obtained in the laboratory. (auth)

33701 RADIOIMMUNOASSAY OF INSULIN. Kagan, A. (Coney Island Hospital, NY). Semin. Nucl. Med.; 5: No. 2, 183-188(Apr 1975).

The powerful nuclear medicine tool of radioimmunoassay was very rapidly developed because of the favorable properties of insulin in such a procedure. The current method of insulin immunoassay in our laboratory is described, with emphasis on the details of the separation of bound and free using talc tablets; emphasis is also given to the correction for tracer damage. The clinical usefulness of the insulin radioimmunoassay is somewhat less than had been anticipated, although its use as a research tool has had immeasurable impact upon the study of metabolism. The presence of proinsulin in plasma is a factor that has to be considered during the radioimmunoassay. Radioimmunoassays for the connecting peptide of proinsulin have also been developed. A preliminary evaluation of two radioimmunoassay kits is described. (auth)

33702 RADIOIMMUNOASSAY OF PLASMA RENIN ACTIVITY. Sealey, J. E.; Laragh, J. H. (Columbia Presbyterian Medical Center, NY). Semin. Nucl. Med.; 5: No. 2, 189-202 (Apr 1975).

Plasma renin activity is quantitated by measuring the rate of angiotensin generation during incubation of plasma renin with endogenous renin substrate. The angiotensin is quantitated by radioimmunoassay. Our studies indicate that the incubation step is best carried out in undiluted plasma at the pH optimum for renin (pH 5.7) in the presence of EDTA, neomycin, and DFP or PMSF. By using these conditions, incubation of low-renin samples can be prolonged for up to 18 hr, because angiotensinases and converting enzyme are completely inhibited. Accuracy is enhanced by prolongation of the incubation time, which results in more angiotensin and eliminates the need for blank subtraction. Incubation at pH 7.4 is disadvantageous because of lower rates of generation of angiotensin I, because of the inability to maintain pH constant without addition of strong buffer, and because the incubation step cannot be prolonged beyond 3 hr. Dilution of plasma is undesirable because it results in a slower reaction rate due to dilution of both enzyme and substrate, and it is not possible to correct for the effect of substrate dilution. The radioimmunoassay of angiotensin I presents few unusual problems. The volume of plasma assayed should be 20 μl or less. If blank subtraction is used, antibodies should be screened to determine the extent to which they bind nonspecific substances in plasma, and then to ascertain whether the blank is entirely additive when angiotensin is added to it. Assay sensitivity is an important issue, since approximately 30% of patients with essential hypertension have subnormal plasma renin activity. In a study of three different commercial kits we found that many low-renin samples were undetectable and major fractions could not be discriminated with precision or consistency from normal renin samples. However, the incubation conditions can be easily modified, so that an 18-hr incubation can be utilized and then low-renin samples can be detected with the same degree of accuracy as those with normal plasma renin activity. (auth)

33703 RADIOLABELING OF ANTIGENS: PROCEDURES AND ASSESSMENT OF PROPERTIES. Chervu, L. R. (Albert Einstein Coll. of Medicine, Bronx, NY); Murty, D. R. K. Semin. Nucl. Med.; 5: No. 2, 157-172(Apr 1975).

The role of labeled tracers in radioimmunoassay procedures (RIA) and the advantages of the iodine-labeled antigens over ^{14}C or tritium-labeled antigens are discussed. Different methods of labeling with iodine isotopes are presented. The ease with which microgram amounts of hormonal proteins are tagged, achieving high specific activity with the chloramine-T procedure of Hunter and Greenwood, is indicated in a detailed presentation of a typical procedure. More sophisticated methods that present none of the drawbacks of the chemical oxidation methods for iodination would seem to have greater versatility, resulting in labeled antigens with better immunologic properties. These are likely to come into vogue for many inhouse preparations of labeled antigens in the next few years. The iodination procedures developed for haptenic substances have extended the usefulness of the RIA method to many steroidal hormones and have helped to achieve a limit of detectability at picogram levels. Greater specificity has also resulted. The assessment of the properties of the labeled antigens is equally important, and methods to evaluate the parameters of purity, immunoreactivity, specific activity as well as storage, are discussed. This review is intended to serve as an introduction to the radiolabeling of antigens or haptens. A thorough appreciation of the problems and pitfalls in these procedures is essential for the development of a new RIA or adaptation of a well-studied method for routine use. (auth)

MATERIALS

33704 (WANL-TME-2783) MATERIALS DATA COLLECTION SYSTEM FOR USE BY MATERIAL AND DESIGN GROUPS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1971. 133p. Dep. NTIS $9.75.

The system has the purposes of maintaining a file of the latest materials data, of supplying printed reports to interested parties, and of allowing design groups computer access to the file. The system consists of three CDC 6600 computer programs: Materials Update Program, Materials Report Writer Program, and Materials to Design Conversion Program. (DLC)

33705 THERMAL EVOLUTION SPECTROMETRY OF LOW ENERGY INERT GAS IONS INJECTED INTO Cu, UO_2, AND GLASS. Cavaleru, A. O. R. (Inst. of Atomic Physics, Bucharest); Morley, C. M.; Armour, D. G.; Carter, G. pp 247-254 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F.R. Germany (24 Sep 1972). See CONF-7209125-.

Low-energy ions were injected into single crystal Cu, sintered UO_2, and glass and the probabilities of entrapment measured as a function of ion energy from 50 eV to 3 keV by heating the targets after irradiation and recording the ratio of quantity of gas released to incident ion fluence. Values of entrapment probability increase from zero at low ion energies to about unity at 1 keV. The rate of thermal gas evolution was also recorded as a function of temperature during the post-bombardment target tempering, enabling deduction of activation energies for evolution. These activation energies are correlated with published data on the annealing of point and extended defects in the solids and with self diffusion energies. (auth)

33706 A LARGE DEFORMATION ANALYSIS OF CRYSTALLINE ELASTIC-VISCOPLASTIC MATERIALS. Bhandari, D. R. (Westinghouse Electric Corporation, Pensacola, Florida, USA); Oden, J. T. (Texas Univ., Austin (USA)). Nucl. Eng. Des.; 29: No. 3, 360-369(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The thermodynamics of crystalline elastic-viscoplastic materials developed earlier by the authors is extended to account for finite strains. The present theory utilizes the basic physical concepts derived from the theory of dislocations in crystals and the thermodynamics of continua with internal state variables. A crystalline simple solid is considered to be a homogeneous elastic-plastic continuum containing dislocations which constitute the intrinsic, internal mechanism of plasticity phenomena. The appropriate internal state variables and the basic constitutive relations for the description of the elastic - viscoplastic behavior are deduced from the consideration of dislocation dynamics. The theory proposed in the present paper is based on the assumption that both elastic and inelastic deformations take place at every stage of loading and unloading. This assumption has a definite physical basis and is the underlying consideration in the field of dislocation dynamics. Unlike other theories, the present one does not require the specification of a yield criterion or the prior determination of whether the material is loading or unloading. It can be shown that under appropriate assumptions on the constitutive laws the present theory reduces to the case of classical thermoelasticity. The general finite-element formulation of an initial boundary value problem is briefly presented. A specific example is carried out in detail which involves the solution of equations governing the coupled thermomechanical response of titanium. To demonstrate the effectiveness of the present formulation, a scheme for calculating the deformations, the stresses and temperature distribution is developed and applied to a three-dimensional structure subjected to high temperature, surface heat flux, volume heat supply as well as mechanical loading. The theory and the analysis should be beneficial in the study of the behavior of reactor materials at high temperatures. (auth)

Ceramics and Cermets

Refer also to abstracts 33300, 33780, 33786, 33804, 33826, 33858, 33890, 33892, 33998, 33999, 34000, 34090, 34462, 35167, 35171, 35172, 35176, 35177, and 35190.

33707 (AD-787847) HOT PRESSED BERYLLIA. Final Technical Report, June 1972-January 1973. Rubin, J. A.; Gardner, W. J. (Ceradyne, Inc., Chatsworth, Calif. (USA)). 29 Oct 1973. Contract N00014-72-C-0421. NTIS $3.25.

Program results showed that to produce a hot pressed beryllium oxide (BeO) ceramic tube for use in a high intensity infrared lamp is a more difficult and complex than originally believed. The lack of uniformity and reproducibility of commercially available BeO powder, which will hot press to the degree of transparency necessary to produce a useful tube, is one of the severest problems encountered. (GRA)

33708 (AD/A-000229) ELECTRONIC AND RADIATION DAMAGE PROPERTIES OF RUTILE. Final Report, 30 June 1970-31 July 1974. (Utah Univ., Salt Lake City (USA). Dept. of Physics). 1974. 43p. NTIS $3.75.

The electronic properties of rutile were studied along with the feasibility of its use as a semiconductor device material. In addition, from a more fundamental standpoint, rutile is an excellent model system for the study of wide gap semiconductors in general. The following studies are reported: impurity thermodynamics, defect thermodynamics, effects of internal fields on diffusion and distribution of ions, ESR measurements, and miscellaneous projects. Results of crystal growth program are reported and problems encountered in developing chemical vapor technique are analyzed. Summary of major achievements of the crystal growth program is given and plans for future research on growth of TiO_2 crystal by chemical vapor transport are outlined. (GRA)

33709 (AD/A-001012) CERAMIC SINTERING. Semiannual Technical Report, 1 April 1974-31 October 1974. Rosolowski, J. H.; Greskovich, C. D. (General Electric Co., Schenectady, N. Y. (USA)). Oct 1974. Contract N00014-74-C-0331. 65p. (SRD-74-116). NTIS $4.25.

Measurement of the rate of oxidation and creep rate in air of chemically vapor deposited Si_3N_4 at around 1500°C are reported. Attempts to prepare pure, dense Si_3N_4 bodies by hot pressing powder at ultra-high pressures were unsuccessful. Resistance heaters made of dense, sintered SiC were tested and found to have in-use lifetimes very much longer than those of commercially available heaters tested in the same way. Microscopic examination of the structures developed during the initial stage sintering of SiC doped with C and B indicates that these dopants inhibit surface diffusion until densification begins at around 1500°C. Bodies of B_4C having about 94% of theoretical density were made by using conventional sintering processes and doping the powder with either SiC or Be_4C. (GRA)

33710 (AD/A-001546) UNIFIED MODEL OF THE INSULATOR-METAL TRANSITION IN Ti_2O_3 AND THE HIGH-TEMPERATURE TRANSITION IN V_2O_3. Zeiger, H. J. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 22 Aug 1974. Contract F19628-73-C-0002. 44p. (ESD-TR-74-245). NTIS $3.75.

A unified band-crossing model of the insulator-metal transition in Ti_2O_3 and the high-temperature transition in V_2O_3 is presented. The model is based on a Hartree-Fock free-energy calculation including electron-electron Coulomb energy, elastic energy, and band-electron entropy, and taking into account the partial overlap of (E_G) (π) bonding and anti-bonding bands. The model calculation is applied to a description of the behavior of lattice parameters, specific heat, Raman frequencies, sound velocity, and magnetic susceptibility through the transition temperature in Ti_2O_3 and V_2O_3. The calculated properties of Ti_2O_3 are found to be at best only in qualitative agreement with experiment, and in the case of the magnetic susceptibility, in serious disagreement. On the other hand, the model predictions are nearly quantitatively correct for many of the properties of V_2O_3. The knight shift and nuclear spin relaxation rate of ^{51}V in V_2O_3 are treated, and found to agree well with experiment. (GRA)

33711 (BMI-1732) PROPERTIES OF URANIUM CARBIDE-BASED FUEL MATERIALS AT ELEVATED TEMPERATURES. Moak, D. P.; Nelson, S. G.; Foster, E. L.; Keller, D. L. (Battelle Columbus Labs., Ohio (USA)). 29 Jun 1965. Contract W-7405-eng-92. 42p. Dep. NTIS $5.25.

Declassified 31 Aug 1973.

Hot hardness and compression tests at temperatures up to 2100°C were performed on uranium carbides and uranium monocarbides with ternary additions of hafnium, molybdenum, niobium, tantalum, titanium, tungsten, vanadium, and zirconium. All of the ternary alloys exhibited increased strength at elevated temperatures. In general, as little as 10 mole % diluent doubled the room-temperature resistivity of UC. Thermal-expansion behavior of UC-5 and -15 mole % WC at temperatures to 1600°C was essentially identical with that of UC. The addition of 5 mole % WC to UC had no detrimental effect on thermal diffusivity above about 400°C.

However, U_2C_3 was inferior to both UC and UC–5 mole % WC. (17 figures, 6 tables) (auth)

33712 (CEA-CONF-2878) REFRACTORY OXIDES FUSED OR VAPORIZED IN A PLASMA FURNACE. Yerouchalmi, D.; Dallaire, S. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France)). [nd]. 8p. (CONF-740750-1). Dep. NTIS (US Sales Only) $4.00.

From sixth symposium on special ceramics, Stoke-on-Trent, UK (9 Jul 1974).

Following the rotary furnace heated by a central beam of plasma and described during the 5th Special Ceramics Symposium (July 1970), a second unit more adapted to further development has been installed at Saclay. Although this furnace is designed for open and controlled atmosphere practice, it is used in a first period of experiments for fusing or vaporizing metal refractory single oxides, such as ZrO_2, MgO, Al_2O_3, SiO_2 and some binary ones like spinels. The installation is described from the furnace itself, to the additional components for controlling the atmosphere. Results of work done on some refractory oxides (MgO) are also given and major trends are discussed. (auth)

33713 (COO-3420-4) CERAMIC RESEARCH ON TRANSFORMATIONAL SUPERPLASTICITY AND STOICHIOMETRY EFFECTS ON FRACTURE. Progress Report, June 1, 1974–May 31, 1975. Bradt, R. C.; Hoke, J. H. (Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences). 1 Mar 1975. Contract AT(11-1)-3420. 30p. Dep. NTIS $4.50.

The progress of the program is reviewed with respect to each of the study areas. In the superplasticity studies the conclusions of the two phase eutectoid work is presented and the current progress on Bi_2WO_6 discussed. The observed effects of stoichiometry on elastic properties and crack propagation are reported and briefly discussed. (auth)

33714 (EURFNR-1205) COATING OF UO_2 PELLETS WITH NIOBIUM METAL. Schneider, H.; Nold, E. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung). Jun 1974. Translation of KFK-2008. 16p. Dep. NTIS $4.00.

Work performed under United States–Euratom Fast Reactor Exchange program.

A coating procedure for UO_2-pellets with metallic niobium is described. The coated pellets will be used as oxygen getter for compatibility tests. The reaction underlying the coating procedure is: $2\ NbCl_5 + 5H_2 = 2\ Nb + 1\ OHCl$. The procedure was carried out in a rotating quartz tube at a temperature of about 800°C. The apparatus used and the experimental setup are described. The pellets coated under these conditions showed dense adherent and uniform layers of niobium metal of 25 to 30 μm thickness. The chloride-content of the coated pellets was below 30 ppM. (auth)

33715 (GEMP-35B) HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 35, PART B. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 28 May 1964. Contract AT(40-1)-2847. 122p. Dep. NTIS $9.25.

Declassified 21 Sep 1973.

Research results are presented on oxidation resistant fuel element materials, reactor controls, reflector materials, shielding materials, refractory metal fuel element materials, direct conversion materials, and graphite fuel element materials. (JRD)

33716 (GESR–2038) DEVELOPMENT OF A NUCLEAR THERMIONIC FUEL ELEMENT. Annual Summary and Eighth Quarterly Progress Report, March 1, 1964–May 31, 1964. (General Electric Co., Pleasanton, Calif. (USA). Special Purpose Nuclear Systems Operation). 1964. Contract AT(04-3)-189. 294p. Dep. NTIS $17.75.

Declassified 31 Aug 1973.

Research programs conducted to develop fuel/clad and insulation materials for thermionic fuel elements are reported. Summaries are presented of research on fuel–emitter materials, thermionic converter development, reactor and system design and single cell development. (JRD)

33717 (GESR-2114) THERMIONIC MATERIAL AND FABRICATION DEVELOPMENT STATUS SUMMARY. Danko, J. C.; Gregory, T. L.; Thompson, J. R. (General Electric Co., Pleasonton, Calif. (USA). Nuclear Thermionic Power Operation). 30 Jun 1968. Contract AT(04-3)-189. 137p. Dep. NTIS $10.00.

Declassified 27 Mar 1975.

Post-irradiation examination of single-cell in-pile converters (SCIPs) and 3-cell thermionic fuel elements (TFEs) was performed to determine possible causes of failure. Emitter development studies were performed on chemical vapor-deposited (CVD) tungsten to determine the nature of a deposit on the internal diameter. The grain growth characteristics of CVD tungsten were also evaluated. The chemical analysis and microstructures of UO_2 fuel used in SCIPs and TFEs were reexamined in an attempt to explain the in-pile behavior of the fueled emitters. This involved a review of the pellet fabrication process and chemistry of the starting material. Electron beam welding parameters of end caps to SCIP and 1-inch TFE emitters were investigated. Improved welding techniques of SCIP envelopes were evaluated and a palladium braze development for intercell joints was performed. Methods of fabricating the sheath-sheath insulator were investigated. A literature search on irradiation behavior of Kovar-type materials was performed and outgassing procedures for the TFE sheath were investigated. Materials and Processing Specifications for all converter parts were reviewed and modified when required. The entire materials development cycle may be visualized as an iterative process guided by three factors entering the cycle at various phases: (1) advances in the state-of-the-art of materials technology, (2) requirements of fabricating SCIPs and TFEs and associated development necessary to achieve this end, and (3) results of the post-irradiation examination of SCIPs and TFEs which identify problem areas. (auth)

33718 (JAERI-M-5567, pp 26-35) THE APPLICATION OF HEAVY ION RESEARCH TO CERAMIC FUELS INVESTIGATIONS. Nasu, S. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Summaries of experimental results on the migration of gas bubbles, heavy-ion damage, and surface oxidation using the channeling technique and Moessbauer-effect observations following Coulomb excitation are briefly presented. Some general trends are pointed out for the application of heavy-ion research to ceramic fuels investigations. (JA)

33719 (JAERI-M-5877) FACTORS INFLUENCING THE YOUNGS MODULI OF COMPACT MATRICES AND FUEL COMPACTS FOR HTGR FUEL. Kikuchi, A.; Iwamoto, K. (Japan Atomic Energy Research Inst., Tokyo). Oct 1974. 22p. INIS.

By an ultrasonic propagation procedure, the Young's moduli of fuel compacts and compact matrixes were measured at room temperature. On the other hand, the density and orientation of the matrixes and the crystallite sizes of the graphite powders were determined to characterize the samples. The Young's modulus increases with content of the amorphous carbon and decreases with increase of the natural graphite in the sample (PCG-NG system). The propagation velocity from which the Young's modulus is calculated depends on the density and orientation in anisotropic samples (NCG system), while it depends only on the density in isotropic samples (MICG system). (auth)

33720 (LA-3496) DEVELOPMENT OF PARTICLES COATED WITH PYROLYTIC CARBON. I. Coatings from Methane at Low Temperatures. Bard, R. J.; McCreary, W. J.; Savage, A. W. Jr.; Baxman, H. R.; Bertino, J. P.; Hayter, S. W.; O'Rourke, J. A.; Tinkle, M. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1966. Contract W-7405-ENG-36. 125p. Dep. NTIS $9.25.

Declassified 28 Aug 1973.

The preparation of particles coated with pyrolytic carbon from methane at low temperatures was studied on a laboratory scale to develop improved coated particles for potential use in graphite-matrix fuel elements. The influence of the conditions of deposition and properties of the pyrolytic carbon coatings and of substrate composition and character on the stability of the coated particles at 2300°C and higher temperatures were determined. Pyrolytic carbon coatings were deposited on fluidized beds of carbon-bed 25 and 40μ diameter UC_2 particles at 1200°, 1300° and 1400°C from methane-helium mixtures in a graphite coater. The coatings with the best resistance to attack by UC_2 at 2300°C were prepared at 1200° and 1300°C and had both high density and high preferred orientation. Pyrolytic carbon coating and testing of 20 to 30 μ-diameter UC_2 particles and of UO_2 particles are described. The best coatings for UO_2 were high-density coatings deposited at high rates at 1200° and 1300°C. Also described are extensive studies to define the mechanics and nature of the coating process, and the methods used to evaluate coatings and coated particles. (auth)

33721 (LIB/Trans-555) QUALITATIVE RELATIONS BETWEEN THE KINETICS OF SINTERING IN HYDROGEN AND THE OBSERVED MICROSTRUCTURES OF URANIUM DIOXIDE. Francois, B.; Delmas, R.; Caillat, R.; Lacombe, P. Translated by W. Buykx from J. Nucl. Mater.; 15: No. 1, 105-110(1965). 8p. Dep. NTIS (US Sales Only) $4.00.

The microscopic study of uranium dioxide sintered in hydrogen, together with density measurements, shows on one hand that the large-scale appearance of pores trapped at the grain boundaries

in the course of sintering has the effect of practically stopping densification, and on the other hand that this particular microstructure is stable over a wide range of time and temperature. (auth)

33722 (SAND-74-8651) IDENTIFICATION OF THE INITIAL-STAGES SINTERING MECHANISM: A NEW APPROACH. German, R. M.; Munir, Z. A. (Sandia Labs., Livermore, Calif. (USA); California Univ., Davis (USA)). Dec 1974. Contract AT(29-1)-789. 25p. (CONF-750501-1). Dep. NTIS $4.25.

From 4th Notre Dame conference on sintering; Notre Dame, Indiana, USA (26 May 1975).

Experimental data showing the reduction in specific surface area during isothermal sintering are analyzed in terms of a previously proposed model. Published data on Al_2O_3, alumina and silica gels, B, Cu, Ni, TiO_2, and As–S–Se glasses are examined through the use of the proposed kinetic relations. It is shown that for the initial sintering stage, this approach provides a useful means for the determination of the dominant mass-transport mechanism. The merits of this approach are related to the traditional shrinkage and neck growth techniques. (auth)

33723 (WANL-TME-1543) ISOLATION OF THE ZETA PHASE IN THE TANTALUM CARBON SYSTEM. Brizes, W. F.; Tobin, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1966. 10p. Dep. NTIS $4.00.

Results of carbide layer growth experiments are described showing that the zeta phase is found as a second phase in substoichiometric TaC. It is proposed, however, that the zeta phase forms on cooling as a result of the decreasing solubility of carbon in the substoichiometric monocarbide with decreasing temperature. In addition to the precipitated zeta found in the monocarbide, a separate layer of single-phase zeta is found in all Ta–C layer growth experiments at isothermal annealing temperatures from 1600 to 2200°C, but not at higher temperatures. The zeta phase has been isolated by means of microdrilling from the separate carbide layer. Results of x-ray analysis indicated a single-phase zeta diffraction pattern. The stability of the zeta phase is indicated by its formation of a separate carbide layer at annealing temperatures and its persistence even after removal of compressive stresses by microdrilling. (auth)

33724 (WANL-TMI-1529) COMPACT THERMOELECTRIC CONVERTER PROGRAM. Lucente, F. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 9 Sep 1965. 8p. Dep. NTIS $4.00.

Tests in progress on properties of PbTe and $MqSiO_3$ are described. Information is also included on property data required on PbTe, BN, and $MqSiO_3$, existing property data, and proposed tests on these materials. (JRD)

33725 (WANL-TR-6595) TRIP REPORT TO LOS ALAMOS SCIENTIFIC LABORATORY, LOS ALAMOS, NEW MEXICO. Holden, A. N.; Singleton, R. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 26 Jan 1971. 10p. Dep. NTIS $4.00.

Development of fabrication procedures for ZrC and ZrC–graphite composites are reported along with those for ZrC–ZrO_2 composites. Information is also included on properties of TaC–NbC–graphite composites. Plots are included on density vs thermal conductivity of ZrC. (JRD)

33726 (WANL-TR-6626) TRIP REPORT TO WNCO. Brizes, W. F.; Miller, D. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Apr 1971. 2p. Dep. NTIS $4.00.

Discussions of coated composite fuel element friction testing, radiography of ZrC billets, and design of hydrogen leaching furnace for carbon removal from ZrC are summarized. (JRD)

33727 (WANL-TR-6649) TRIP REPORT TO ABAR CORPORATION. Brizes, W. F.; Duran, E. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 11 Jun 1971. 2p. Dep. NTIS $4.00.

Their first attempt was unsuccessful. However, their furnace and personnel appear to be capable of satisfying the requirements for H_2 of leaching ZrC. A number of problems were encountered in their first run as outlined below, but these are not considered major and should be solved by a redesign of their furnace retort. (auth)

33728 (WANL-TR-6661) TRIP REPORT TO ABAR CORPORATION, FEASTERVILLE, PENNSYLVANIA. Cooper, L. H (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Jul 1971. 2p. Dep. NTIS $4.00.

Primary importance was assigned to providing positive means of assuring high temperature H_2 flow past the ZrC pieces. Abar Corporation agreed to make the suggested changes in their tungsten basket and relocate H_2 preheater external to their furnace jacket for this purpose. It was also agreed that Abar Corp. would proceed with the trial leaching run immediately on completion of the fixturing and receipt of the ZrC pieces from WANL. (auth)

33729 ELECTROCHEMICAL COMPOSITE COATINGS WITH NICKEL WITH OCCLUSIONS OF TITANIUM CARBIDE AND BORON NITRIDE PARTICLES. Antropov, L. I.; Bykova, M. I.; Shklyanaya, I. V.; Nastenko, N. Ya. (Kiev Polytechnic, Inst.). Prot. Metals (USSR) (Engl. Transl.); 10: No. 4, 354-356(1974).

Translated from Zashchita Metallov; 10: No. 4, 382-385(1974).

Results are presented of studies on the effect of the type of electrolyte during electrodeposition of nickel with suspensions of titanium carbide and boron nitride particles on the composition and physicomechanical properties of composite coatings. (auth)

33730 IR-SPECTRA OF GADOLINIUM, TERBIUM, DYSPROSIUM, AND HOLMIUM TITANONIOBATES WITH THE EUXENITE STRUCTURE. Sych, A. M.; Klenus, V. G. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 8, 1396-1398(Aug 1974). (In Russian).

The ir spectra of polycrystalline $LnTiNbO_6$ (where Ln is Gd, Tb, Dy, or Ho) were obtained in the region from 30 to 1500 cm^{-1}. The interpretation of the observed spectra were given with consideration of the theoretical group analysis of the oscillation of the crystalline lattice of the euxenite type (space group D_{2h}^{14}, Z = 4). In the region of oscillation of MeO_6 the observed multiplicity of the spectra can be explained by the inclusion of the normal oscillation of the oxygen octahedron of $TiO_6(NbO_6)$ occurring in the low symmetry field of euxenite crystals. (tr-auth)

33731 ISOTROPIC ELASTIC DEFORMATION IN TWO-PHASE ALLOYS. Poltavtsev, N. S.; Pryanchikov, E. N.; Sagalovich, V. V.; Slezov, V. V.; Khrebtov, V. L. (Physical-Technical Inst., Kharkov). Sov. Phys.-Solid State (Engl. Transl.); 16: No. 7, 1234-1236(Jan 1975).

Translated from Fiz. Tverd. Tela; 16: No. 7, 1890-1894(Jul 1974).

High-temperature x-ray studies have been carried out on the two-phase alloys Mo–Al_2O_3 and Mo–ZrO_2. It is shown that, depending on the elastic and thermal properties of the materials of the matrix and the dispersed particles, the molybdenum matrix may occur in a state of isotropic tension or compression. (auth)

33732 MAGNETIC HYPERFINE INTERACTIONS FOR $^{119}Sn^{4+}$ IMPURITY IONS IN VO_2. Fabrichnyi, P. B.; Balyar, M.; Pushar, M.; Babeshkin, A. M.; Hagenmuller, P. (Moscow State Univ.). Sov. Phys.-Solid State (Engl. Transl.); 16: No. 7, 1375-1376 (Jan 1975).

Translated from Fiz. Tverd. Tela; 16: No. 7, 2109-2111(Jul 1974).

Moessbauer spectroscopy of impurity ^{119}Sn was used to study VO_2. To explain the results obtained for $^{119}Sn^{4+}$ in VO_2, it is proposed that on substitution of Sn^{4+} impurity for V^4, the Sn^{4+} ions liberate part of the V spins except for those combined in V–V pairs. These liberated spins may form antiferromagnetic pairs, thereby causing magnetically ordered clusters in the low-temperature VO_2 structure. Since the Sn-impurity concentration in the sample is low, such an explanation assumes the irregular distribution of Sn^{4+} ions in VO_2, in the form of aggregates. This qualitatively corresponds to the observed broadening of the hyperfine spectral component. (auth)

33733 ELECTRIC PERMITTIVITY OF VANADIUM PENTOXIDE. Chernenko, I. M.; Ivon, A. I. (Dnepropetrovsk State Univ., USSR). Sov. Phys.-Solid State (Engl. Transl.); 16: No. 7, 1391-1392(Jan 1975).

Translated from Fiz. Tverd. Tela; 16: No. 7, 2130-2132(Jul 1974).

Results of measurements of the electric permittivity of monocrystalline and polycrystalline V_2O_5 at frequencies of 700 kHz and 10 MHz at 77 and 280°K are presented. Results are presented in curves showing the temperature dependence of the permittivity in polycrystalline and monocrystalline samples of V_2O_5. An analysis of these results is included. (JRD)

33734 OPTICAL ABSORPTION IN MONOCRYSTALS OF V_2O_5. Volzhenskii, D. S.; Savitskii, V. G. (Lvov State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 151-153(1974). (In Russian).

The infrared optical absorption spectra of V_2O_5 single crystals were studied at incident photon energies of 0.4 to 1.45 eV. The electric conductivity and absorption coefficient in the band maximum were determined as a function of the growth conditions and type of processing of the samples. A dependence between the absorption and electroconductivity was detected, and the reasons for this dependence are discussed. (JSR)

33735 EFFECT OF ELECTRICAL FIELD ON THE OPTICAL ABSORPTION SPECTRA OF ELECTRON-IRRADIATED ALKALI BORATE GLASSES. Vakhromeev, V. G.; Zinov'ev, S. P. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 146-148(1974). (In Russian).

The effect of an external electrical field on the optical absorption spectra induced by electron irradiation was studied using $6B_2O_3 \cdot Na_2O$ glass irradiated at room temperature in air. The results show that the optical absorption and the number of color centers causing the absorption decrease after immersion in a field with an intensity of 7×10^5 V/cm. At lower field intensities the effect is not observed, and at higher intensities electric breakdown occurs. (JSR)

33736 NEUTRON DIFFRACTION STUDIES ON $(SE_{0.5}U_{0.5})O_2$ (SE = Y, La, Nd, Ho, AND Lu). Weitzel, H. (Technische Hochschule, Darmstadt, Ger.)(Keller, C. J. Solid State Chem.; 13: No. 1-2, 136-141(Feb 1975). (In German).

Neutron diffraction studies of $(RE_{0.5}UO_{0.5})O_{2.00}$(RE = Y, La, Nd, Ho, Lu) and $(La_{0.67}U_{0.33})O_{2.00}$ ternary oxides proved that these ternary oxides crystallize in the fluorite structure. The oxygen atoms are located on the normal anion sites of the fluorite structure, thus excluding a covalent UO_2^{2+} group. In these ternary oxides the lanthanide atoms as well as U(V) and U(VI) have a nondistorted cubic environment (coordination No. 8); for U(VI) such a coordination is reported for the first time. The mean vibration amplitude of the oxygen atoms $(\overline{U_{80}^2})^{1/2}$ and the lattice constant increases with the mean ionic radius of the metal atoms in the $(RE_{0.5}U_{0.5})O_{2.00}$ phases. (auth)

33737 NEW $A^{III}B^{III}O_3$ INTERLANTHANIDE PEROVSKITE COMPOUNDS. Berndt, U.; Maier, D.; Keller, C. (Kernforschungszentrum, Karlsruhe, Ger.). J. Solid State Chem.; 13: No. 1-2, 131-135(Feb 1975).

The new interlanthanide perovskites $LaHoO_3$, $CeLuO_3$, $CeYbO_3$, $CeTmO_3$, $PrLuO_3$, $PrYbO_3$, and $NdLuO_3$ were prepared by solid state reactions. $PrYbO_3$ and $NdLuO_3$ are metastable at high temperatures and cannot be prepared by heating up the mechanically mixed binary oxides. The thermal stability of the $A^{III}B^{III}O_3$ perovskites decreases with increasing ionic radius of B(III), the dissociation temperatures of $LaHoO_3$ and $LaYO_3$ being 1300°C and 1470°C, respectively. No perovskites with A = Pu and Am were obtained; therefore the existence of $A^{III}B^{III}O_3$ lanthanide–actinide and of interactinide perovskites can be excluded. Lattice constants, detailed preparation methods, and the phase diagrams of the systems $LaO_{1.5}$–$HoO_{1.5}$, $LaO_{1.5}$–$YO_{1.5}$, and $LaO_{1.5}$–$SmO_{1.5}$–$YbO_{1.5}$ are reported. (auth)

33738 NEW TERNARY OXIDES OF DIVALENT EUROPIUM OF THE QUADRATIC TUNGSTEN OXYGENATED BRONZE TYPE AND PEROVSKITE TYPE. Fayolle, J. P.; Studer, F.; Desgardin, G.; Raveau, B. (Univ., Caen, France). J. Solid State Chem.; 13: No. 1-2, 57-64(Feb 1975). (In French).

New divalent europium ternary oxides were isolated and studied by X-ray diffraction and electronic microscopy. Fifteen of them crystallize with tetragonal bronzelike structure: EuM_2O_6; $Eu_3M_{24}O_{84}$ (M = Ta, Nb); $EuBCM_5O_{15}$ (B = Ca, Eu, Ba; C = Na, K; M = Ta, Nb) and $Eu_{0.60}NbO_3$. The compound Eu_xNbO_3 ($0.80 \leq x \leq 0.90$) is of perovskite type. Structural evolution of these phases compared to the strontium homologous compounds is discussed. (auth)

33739 MAGNETIC SUSCEPTIBILITY OF THE URANIUM NITRIDES. Troc, R. (Inst. for Low Temperature and Structure Research, Wroclaw). J. Solid State Chem.; 13: No. 1-2, 14-23 (Feb 1975).

The magnetic susceptibility of UN, and of the higher uranium nitrides was measured over a wide temperature range, i.e., 4.2–950 K. A large temperature-independent term χ_0 equal to $310 \pm 10 \times 10^{-6}$ emu/mole was derived from the total susceptibility data of UN. The obtained χ_M values of UN are also related to the Knight shift data from literature. For the higher nitrides U_2N_{3+x} the magnetic susceptibility was measured for N : U ratios between 1.55 and 1.80. Antiferromagnetic phase transitions were found for all the examined compositions. The transition temperature T_N gradually decreases as the nitrogen content increases, varying from 94 K for $UN_{1.55}$ to about 8 K for the maximum composition of $UN_{1.80\pm0.02}$. The magnetic properties of the higher nitrides are discussed in terms of mixed valency states, either U^{4+} and U^{6+} or U^{4+} and U^{5+} for the stoichiometric U_2N_3. (auth)

33740 DEVELOPMENT TRENDS IN RECENT FUELS FOR HIGH TEMPERATURE GAS COOLED REACTOR. Hosaka, A. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)). Ishikawajima-Harima Giho; 14: No. 4, 395-405(Jul 1974). (In Japanese).

Introduction of the concept and the development of a coated particle fuel has played a major role in realizing the high temperature gas cooled reactor for commercial use. The coated particle fuel, several hundred microns in diameter, comprises a fissile or fertile kernel wrapped in a number of layers of pyrocarbon or silicon carbide coating to retain the fission products. The coated particle fuel is dispersed into a carbon matrix and is then formed into a fuel element, a unit for fuel exchange. This article presents an outline of these fuels and describes recent developments abroad. Of particular mention are the methods of mass-production of fuels and inspection of quality control, centering on the commercial use of large high temperature gas cooled reactor. Feasible fuel cycles and chemical processing methods are also mentioned briefly. (auth)

33741 STUDY ON WELDABILITY OF DISPERSION HARDENING ALLOY. III. Behavior of ThO_2 Particles in Solid Matrix. Ikawa, H.; Shin, S. (Osaka Univ., Suita (Japan). Faculty of Engineering); Habu, M. Yosetsu Gakkaishi; 43: No. 8, 776-785 (Aug 1974). (In Japanese).

The relationship between the heat treatment conditions and the behavior of ThO_2 particles in solid matrix is discussed to get fundamental informations on the solid state bonding of TD nickel. The results obtained from this study are summarized as follows: (1) ThO_2 particles begin to grow at a temperature near the melting point of matrix nickel and the agglomerating process of the particles takes place as the first step of the growth. The particles agglomerated and grown have the same crystal structures as those of ThO_2 particles and the volume fractions of these particles do not change after growth. (2) The features mentioned above are not explained by the ordinary growth mechanisms of oxide particles, so the authors propose a different mechanism of growth based on the self-diffusion process of matrix atom, the adhesion process among ThO_2 particles and the decrease of interfacial energy among the matrix and ThO_2 particles. (3) It is confirmed that the dispersion hardening effects of ThO_2 particles decrease as ThO_2 particles grow larger than 900 Å in the mean diameter. (4) In case of the solid state bonding, if the bonding conditions satisfy the time temperature regions, the dispersion hardening effects of ThO_2 particles are expected to be preserved at bonding interface. (auth)

33742 PHASE DIAGRAM OF THE SYSTEM BeO–ThO_2. Ohta, T.; Sata, T. (Tokyo Inst. of Tech. (Japan). Research Lab. of Engineering Materials). Yogyo Kyokai Shi; 82: No. 947, 397-401 (Jul 1974). (In Japanese).

The system BeO–ThO_2 was studied for the purpose of realizing the secondary fixed point for temperatures over 2000°C in the perfect binary system and of taking some information on nuclear materials and their ceramic coatings. The following data were obtained. Both α-BeO and ThO_2 coexisted below 2107 ± 15°C at which temperatures the $\alpha \rightarrow \beta$ transition of BeO occurred over all the compositions. Both β-BeO and ThO_2 coexisted between 2107 ± 15 and 2175 ± 8°C. The eutectic temperature was 2175 ± 8°C at a composition of 21 ± 1 mol% ThO_2. The heats of fusion of pure BeO and ThO_2 which were very difficult to obtain were estimated from the liquidus lines, assuming the ideal solution law near the both end members, obtained as 7.6 ± 2.1 and 14.7 ± 2.2 kcal · mol^{-1}, respectively. The transition temperatures of BeO in the system BeO–ThO_2 were constant over all the compositions, though its reproducibility was slightly decreased by the addition of ThO_2 component. The eutectic temperature was obtained with a very stable and reliable precision, so it would be possible to use as a secondary fixed point of temperature near 2200°C, like the transition temperature of pure BeO might be used near 2100°C. (auth)

33743 THE ANOMALY OF THE TEMPERATURE DEPENDENCE OF THE HYPERFINE MAGNETIC FIELD AT Sn NUCLEI IN $MnFe_2O_4$ FERRITE. Lyubutin, I. S.; Dmitrieva, T. V. (An SSSR, Moscow. Inst. Kristallografii); Ohya, T.; Ono, K. J. Phys. Soc. Jap.; 36: No. 4, 1006-1009(Apr 1974).

The temperature dependence of hyperfine magnetic fields at ^{57}Fe and ^{119}Sn nuclei in $Mn_{1.01}Fe_{1.99}Sn_{0.01}O_4$ ferrite was investigated. The hyperfine field at tin nuclei shows a maximum as temperature is varied. This anomaly may be explained quantitatively by assuming the supertransfer of the 3d-spin density from iron to tin and the direct overlap of iron and tin orbitals. (JA)

33744 PREPARATION AND SOME PROPERTIES OF YTTERBIUM CARBIDE HYDRIDES. Haschke, J. M. (Univ. of Michigan, Ann Arbor). Inorg. Chem.; 14: No. 4, 779-783(Apr 1975).

Equilibria in the ytterbium–carbon–hydrogen system were investigated for various carbon to metal ratios at 900°C and 0.5 atm of hydrogen. Samples were prepared by reaction of the dihydride and graphite in molybdenum containers. Two ytterbium carbide hydride phases were identified by x-ray diffraction and chemical analysis; hexagonal $YbC_{0.5}H$ (a = 3.575 ± 0.002, c = 5.786 ±

0.004 Å) and fcc $YbCH_{0.5}$ (a = 4.974 ± 0.001 Å) were observed. Magnetic, electrical, and hydrolysis data were obtained and employed in describing these phases on the basis of ionic models. Structures that account for the observed nonstoichiometry and phase equilibria of the carbide hydrides are proposed. In the presence of oxygen, metastable fcc products with lattice parameters in the range 4.85 to 4.96 Å were observed between the $YbO_{0.5}C_{0.5}$ and $YbCH_{0.5}$ compositions; this quaternary phase appears to be the metal-rich carbide reported for the composition range $YbC_{0.33}-YbC_{0.43}$. Attempts to prepare the analogous carbide hydrides of europium were unsuccessful; however, the previously reported metal-rich europium carbide, EuC_x, was identified as EuO. (auth)

33745 OPTICAL PROPERTIES OF ION BOMBARDED SILICA GLASS. Bayly, A. R. (Univ. of Sussex, Eng.). pp 255-262 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F.R. Germany (24 Sep 1972). See CONF-7209125-.

Refractive index profiles, produced by ion irradiation in silica glass, were measured using ellipsometry by sectioning the implanted region, obtaining a series of measurements at progressively deeper levels, and analyzing the profile as a stack of thin homogeneous layers. Results were obtained for He^+, Ar^+, and Kr^+ implantations using hydrofluoric etching as the sectioning technique. It is found that the profile consists essentially of a shallow peak near the surface of 1.0 → 1.5% change in index, and a deeper peak which seems to saturate at a change of ~1.0%. The deep peak shows good agreement with theoretical damage distributions for low dose He^+ but shows signs of saturation after a dose of $5 \cdot (10)^{15}$/cm^2 20 kV He^+. For Ar^+ and more so for Kr^+ at doses of $1 \cdot (10)^{16}$ ions/cm^2 at 300 kV there appears significant broadening of the profiles compared to theory. Although this might be explained by damage saturation the lack of any obvious implantation effect suggests a possible explanation in terms of a redistribution of the implanted species by the compaction effect which occurs in silica. Alternatively the implanted species may oppose compaction. Backscattering studies are proposed to resolve these questions. (auth)

33746 FRACTURE IN A DIRECTIONALLY SOLIDIFIED NICKEL-(CHROMIUM)-TANTALUM CARBIDE FIBROUS EUTECTIC UNDER MONOTONIC AND CYCLIC LOADING. Henry, M. F. Troy, NY; Rensselaer Polytechnic Inst. (1974). 324p. University Microfilms Order No. 75-5358.

Thesis (Ph. D.).

High temperature directionally solidified eutectics have been identified as potential candidate materials for future gas turbine applications. This requires, among other things, an understanding of the mechanical behavior of these systems. The fracture behavior, under monotonic and cyclic loading, of a Ni(Cr)-TaC model system has been studied. The directionally solidified alloy has five volume percent TaC fibers approximately 1.8 μm square, with both phases having a preferred {100} growth direction and a common {110} interface. The tensile behavior has been examined from room temperature to 1000°C. The internal thermally induced residual stresses due to the large difference in thermal expansion coefficients of the two aligned phases has been calculated and experimentally verified. At room temperature, the matrix has 45 ksi tension and the fibers 800 ksi compression residual stress. These stresses disappear at approximately 1075°C. In tension, the TaC fibers fracture initially due to pile-up of matrix slip bands on {111} planes against the fibers. Significant fiber failure at 25 and 1000°C occurs at 1.3 and 1.0% strain, respectively. The composite undergoes significant deformation after fiber failure with true strain at failure ranging from 80% at 25°C to 60% at 1000°C. The decrease in ductility is due to diminished strain hardening capacity with increasing temperature. Composite failure is initiated at fiber fracture sites and is by hole growth and coalescence at moderate and fast strain rates. The elevated temperature composite failure becomes like that at room temperature as the strain rate is increased. In Charpy-V-notch tests, the fracture surfaces from 25 to 1000°C are identical. Compression tests at room temperature gave plastic buckling of TaC fibers due to the hydrostatic compressive stress. The strain cycled fatigue behavior was examined at 25 and 1000°C in air. The material showed a unique hysteresis behavior that allows assessment of the fiber integrity. When the cyclic strain range is not sufficient to cause fiber failure, the hysteresis loop approximates a parallelogram. The residual stresses observed in tensile and compressive tests were confirmed in cyclic, fully reversed tests. At high cyclic plastic strains, fibers fracture on the first cycle and matrix fatigue cracks initiate at those sites. At lower cyclic plastic strains, fatigue cracks initiate in matrix at extrusions on slip bands and fibers are broken only where the macrocrack crosses them. At very low cyclic strains, the fibers are capable of locally deflecting the crack growth rates, mini-striations, postulated to form concurrently at fiber fracture sites ahead of the main crack, are seen on the fracture surface. At higher crack rates, macrostriations seem independent of the fibers, but do outline the size at the time the main crack grew through of the cavity formed at each fiber fracture site. This monocarbide reinforced eutectic does obey the Coffin-Manson plastic strain versus life relation at 25 and 1000°C in air. The correlation holds through the strain regime separating early fiber failure from no significant fiber failure until near end of life. The strain cycled fatigue behavior is judged to be matrix controlled. This was demonstrated by the continuous Coffin-Manson plot, and a specimen prestrained to give significant fiber failure which gave the same life as a virgin specimen when subsequently tested at a strain range which would not normally fracture fibers until near end of life. Ni(Cr)-TaC is equivalent to conventional structural materials in fatigue resistance at room temperature and at 1000°C is essentially equivalent to cast René 80, a conventional nickel-base superalloy, at 870°C. (Diss. Abstr. Int., B)

33747 INVESTIGATION OF ELECTRON IRRADIATION EFFECTS ON SiO_2-Si SURFACES USING THE ENERGY DISTRIBUTION OF SECONDARY ELECTRONS. Chiu, K. Y. Los Angeles; Univ. of Southern California (1974). 107p. University Microfilms Order No. 75-6405.

Thesis (Ph. D.).

Surface potential changes in SiO_2-Si surfaces under periodic electron bombardment have been studied by using the energy distribution of secondary electrons produced by 3 to 10 kV primary electrons. Oxides of various thickness, thermally grown by wet and dry processes on both N-type and P-type substrates of various resistivity were examined. It was found that the behavior of change in surface potential with beam chopping frequency depends very little on oxide thickness and type of oxide (dry or wet). The frequency dependence of the surface potential is interpreted as being due to radiation induced charge developed in the oxide at the oxide-semiconductor interface, greater positive charge being produced at low electron beam energies. This effect is qualitatively explained by the voltage dependence of processes that yield positive charge buildup. (Diss. Abstr. Int., B)

33748 FIZICHESKAYA ELEKTRONIKA, MATERIALY ELEKTRONNOI TEKHNIKI I PRIKLADNAYA FIZIKA. (Physical Electronics, Materials of Electronic Technique, and Applied Physics). Arifov, U. A. (ed.). Collection of Scientific Works. Volume 6. Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). 376p.

Papers are presented on ion emission from surfaces under electron and ion bombardment, surface properties of hot metal and oxide films, electronic properties of surfaces, radiation effects on inorganic materials, and radiation detection devices and techniques. Twenty-nine papers were selected for inclusion in NSA. (SFL)

For abstracts of individual papers see: 33190, 33282, 33749, 33750, 33936-33942, 34015-34019, 34058-34064, 34139-34141, 34188, 34492, and 35208.

33749 ELECTRON EMISSION OF THIN B_2O_3 LAYERS ON BOMBARDMENT BY POSITIVE IONS. Starodubtsev, S. V. pp 75-77 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

Bombardment of thin dielectric films on a metal backing by electrons causes the appearance of an intense, particular electron emission from the bombarded targets. The reason for the emission is a positive charge on the surface of the dielectric. A tungsten wire spiral covered with pressed B_2O_3 powder served as a source of positive ions (potassium contaminant in B_2O_3) and as an evaporator for obtaining dielectric films. The total current in a nickel collector was measured by a galvanometer. After turning on the wire spiral to incandescence a gradual increase in total current was noted with a sudden jump being observed at a film thickness of $\sim 2 \times 10^{-4}$ cm because of a sharp increase in electron emission of the film. Tests were made to prove the absence of gas-discharge ion currents in the equipment. As a whole the emission was caused by electrons extracted by the field of the positive charge of the film. Analogous results were obtained with KCl and films of MgO and BaO. (SJR)

33750 ELECTRON EMISSION OF DIELECTRIC FILMS ON BOMBARDMENT BY POSITIVE IONS. Starodubtsev, S. V. pp 96-99 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

The cause of the electron emission is the positive charge on the surface of the dielectric. The purpose of this study was to confirm the possibility of obtaining electron emission from thin

dielectric films of B_2O_3 that had been charged by bombardment by positive ions. The total current was measured, and this current I_i is equal to the sum of the primary positive ion current and the secondary electron current: $I_i = I_e + I_{pos}$. After turning on the current to the spiral a gradual rise in current I_i is noted. At a certain film thickness the current suddenly increases from 3×10^{-6} a to 0.6 ma. Further increase in current at a voltage of 600 v is limited only by the external resistance of 1 megaohm. The increase in total current occurred basically as a result of the electron component. The film thickness is equal to $\sim 2 \times 10^{-4}$ cm. The film charge is independent of the means of excitation, and in some manner it must be distributed over the entire thickness of the film. (SJR)

33751 DIFFUSION OF H AND D IN TiO_2: SUPPRESSION OF INTERNAL FIELDS BY ISOTOPE EXCHANGE. Johnson, O. W.; Paek, S. H.; DeFord, J. W. (Univ. of Utah, Salt Lake City). J. Appl. Phys.; 46: No. 3, 1026-1033(Mar 1975).

Measurements of H and D diffusion in TiO_2, using an isotope exchange technique are reported. Use of this technique resulted in diffusion which was accurately described by Fick's law with a constant diffusion coefficient, as predicted theoretically, in sharp contrast to single ion diffusion, where dramatic departures from classical diffusion theory were observed. The measured diffusion coefficients for H were 1.8×10^{-3} exp(−0.59eV/kT) and 3.8×10^{-1} exp(−1.28eV/kT) cm^2/sec for diffusion || and ⊥ to the c axis, respectively. Ionic conductivity measurements are reported, which agree well with the bulk diffusion measurements, and permitted us to extend the temperature range of the measurements for c-axis diffusion from 125 to 750°C, corresponding to a range of more than four orders of magnitude in D. The measured diffusion parameters were found to be essentially independent of sample purity, although it was observed that significant concentrations of lattice defects sharply inhibited H diffusion. (auth)

33752 STUDIES ON BOMBARDMENT-ENHANCED CONDUCTIVITY. IV. On the Chemical State of Oxygen-Bombarded Nb_2O_5. Murti, D. K. (McMaster Univ., Hamilton, Ontario (Canada). Inst. for Materials Research); Kelly, R. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). Surface Sci.; 47: No. 1, 282-293(Jan 1975).

From 3rd international symposium on surface physics; Utrecht, The Netherlands (26 Jun 1974).

It is a well-established result that an increased oxygen content in bombarded metal targets influences the yields of secondary ions or photons. A similar influence appears to have been identified also for a decreased oxygen content in the case of bombarded oxide targets. The chemical state of targets which have gained or lost oxygen is less often specified and work was therefore undertaken to determine this state in a particular system, oxygen-bombarded Nb_2O_5. The results relate to conductivity, annealing, and electron diffraction. Specifically, intermediate doses ($\leq 4 \times 10^{15}$ ions/cm^2) of 35 keV oxygen ions led, as with many other substances, to amorphization with unchanged conductivity. Doses in excess of 2×10^{17} ions/cm^2, however, caused an increase in the bulk conductivity of a factor of about 4×10^8 as well as a corresponding stoichiometry change such that oxygen was lost and a thin layer of crystalline NbO was formed. These changes persisted when bombarded specimens were heated in vacuum at 150−800°C. The results are discussed from the standpoint of three mechanisms, namely thermal-spike induced vaporization, internal precipitation, and preferential sputtering. Vaporization could be excluded on the basis of the oxygen partial pressure for the process Nb_2O_5 (l) = 2 NbO (l) + $\frac{1}{2}O_2$ (g) being too low, while precipitation could be tentatively excluded on the basis of the vacuum annealings. There were no obvious objections, however, to a model for oxygen loss based on preferential oxygen sputtering even if the details of the model were unclear. (auth)

33753 LOW-TEMPERATURE THERMO EMF OF BINARY ALLOYS OF NICKEL WITH TRANSITION METALS. Beilin, V. M.; Zeinalov, T. L.; Rogel'berg, I. L.; Cherenkov, V. A. Fiz. Metal. Metalloved.; 38: No. 6, 1315-1318(Dec 1974). (In Russian).

The temperature dependence of the thermo emf of binary alloys of Ni with In, Ti, Zr, Ta, Cr, Mo, V, W, and Re was studied in the temperature range from 4.2 to 300°K. The dependence curves obtained show that with increase of the concentration of the admixture the maximum in the curves is displaced to the high temperature side and its height is increased. The dependence of the thermo emf maximum on the temperature was shown. The positive thermo emf of the binary alloys studied, in contrast to alloys with Fe, Cu, or Co indicates that admixtures of non-ferromagnetic transition metals enter into the matrix with antiparallel moments. The residual resistance of the alloys was also measured and the results are tabulated. (JSR)

33754 IONIC AND GAMMA-RAY INDUCED PHOTOCONDUCTIVITY OF MgO. Lynch, G. F. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys.; 53: No. 3, 210-218(1 Feb 1975).

The d. c. electrical conductivity of MgO was measured, both in the presence and in the absence of an intense γ-ray field, in the temperature range 300 to 600 K. Outside the radiation environment, the conductivity is attributed to the migration of positive ion vacancies, with an activation energy of 1.50 eV. The magnitude of the conductivity is much larger than would be expected from the normal vacancy concentration and this is explained by extra magnesium vacancies acting as charge compensators for trivalent transition metal ion impurities. In the γ-ray radiation field of a ^{60}Co source, the observed photoconductivity is described by a trapping model, with levels at 0.04, 0.55, and 1.35 eV below the conduction band. The γ-ray induced conductivity is consistent with a linear dependence on the radiation dose rate up to 4.0×10^5 rad/h (H_2O).

33755 THERMODYNAMICS OF THE PRECIPITATION OF ZIRCONIUM NITRIDE FROM THE GASEOUS PHASE. Vasil'ev, V. M.; Martynov, S. Z.; Pavlov, Yu. A.; Petrov, Yu. M. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 1, 11-15(1975). (In Russian).

The results of the thermodynamic and experimental study of the process of precipitation of zirconium nitride from gaseous phases containing N_2, H_2, and $ZRCl_4$ were reported. The calculations were made with consideration of 18 components in the temperature interval from 1500 to 2500°K for pressures of 0.02, 0.05, 0.1, 0.5, and 1 atm, and for different ratios of the reacting components. With increase of the concentration of N_2 and particularly H_2 the equilibrium yield of the nitride in the condensed phase is significantly increased. Experimental data satisfactorily agrees with the calculations. (tr-auth)

33756 EFFECT OF REACTOR IRRADIATION ON THE DISSOCIATION PRESSURE OF ZIRCONIUM HYDRIDE. Karasev, V. S.; Kovyrshin, V. G.; Yakovlev, V. V. Sov. At. Energy (Engl. Transl.); 37: No. 1, 745-746(Jul 1974).

Translated from At. Energ.; 37: No. 1, 65-66(Jul 1974).

Samples of ZrH_x were irradiated in hermetic ampoules with a system of pressure measurement and a controllable rate of hydrogen extraction for variation of the H content. The error in determining the sample temperature was given special attention. Results are given for x = 0.9 to 1.4 and irradiation temperatures of 900 to 1100°K. Graphs and activation energies are given. (DLC)

33757 COMPOSITION AND MICROSTRUCTURE OF BINDER PHASES OF SLOWLY COOLED WC−Co CEMENTED CARBIDES. Jonsson, H. (Fagersta-Seco AB, Sweden). Planseeber. Pulvermet.; 21: No. 3, 187-208(Sep 1973).

After sintering, WC−Co cemented carbides usually consist of two phases, tungsten carbide, WC, and a cobalt-rich solid solution of tungsten and carbon, the binder phase. At low carbon contents mixed carbides often of the M_6C-type (M = W, Co) may occur in addition to WC and binder phase; at high carbon contents free carbon might be present as carbon porosity. After selective dissolution of the binder phases chemical analyses of the binder phases were performed by gravimetric methods. The results are compared with results obtained by x-ray diffraction techniques (lattice parameter measurements). The composition of the binder phase changed during slow cooling to room temperature. As the composition of the binder phase after slow cooling to room temperature was observed to vary with the microstructure even for three-phase alloys it was concluded that equilibria are not obtained in cemented carbides as conventionally prepared. Concentration gradients inside binder phase areas could possibly explain the experimental results obtained. In alloys consisting of tungsten carbide, WC, binder phase and mixed carbides a typical composition of the binder phase was 88.8% Co−11% W−0.2% C, in alloys consisting of WC, binder phase and free carbon a composition such as 96.5% Co−3% W% 0.5% C is suggested. From microstructural studies it was indicated that primary WC-grains act as nuclei when WC precipitates from the binder phase. (auth)

33758 UO_2BeO FUEL PROCESS. Rubin, J. A.; Johnson, P. D. (to Energy Research and Development Administration). US Patent 3,865,746. 11 Feb 1975. Filed date 16 Jul 1959. 6p.

A method of forming a UO_2-BeO ceramic body is described which comprises melting together uranium nitrate and beryllium nitrate to a temperature of approximately 50 to 100°C, heating the resulting melt until a homogeneous mixture of beryllium oxide and uranium oxide is obtained, hot-pressing the resulting composition at approximate conditions of 1,200 to 2,000°C, at a pressure of 1,000 to 6,000 psi for one-half to 6 hours. (Official Gazette)

33759 INTRINSIC POINT DEFECTS IN OXIDES WITH THE RUTILE STRUCTURE. Weeks, R. A. (Oak Ridge National

Lab., TN). pp 27-38 of Recent Advances in Science and Technology of Materials. Vol. I. Bishay, A. (ed.). New York; Plenum Publishing Corp. (1974).

The oxides considered have the rutile structure and are formed from elements of the fourth (Si, Ge, Sn, Ti) group of the Periodic Table. Instrinsic point defects of these oxides, oxygen and cation vacancies, cation interstitials, and interstitial oxygen molecule ion complexes, have optical and magnetic properties which are a function of their charge state. Properties of the various charge states of oxygen vacancies can be described in terms of linear combinations of s and p states of nearest-neighbor cations, with the exception of TiO_2, for which a linear combination of d orbitals of the three nearest-neighbor Ti ions is required. Paramagnetic states of oxygen vacancies in these oxides have been observed, and comparison of their properties and rates of production by reactor irradiation exhibits many differences. Electron paramagnetic resonance spectra which have been observed for singly charged oxygen vacancies in glassy SiO_2 and GeO_2 are compared with those produced in the rutile phases. Configurations of interstitial oxygen ions have several forms, data about which have been derived from electron paramagnetic resonance spectra. Definitive models which have been deduced in a few cases, e.g., O_2^- and O_3^- molecule ions, are discussed. Reasons for the failure to detect either optical absorption bands or paramagnetic states of interstitial cations, with the exception of Ti^{3+} and interstitial oxygen ions in the case of TiO_2 are discussed. (auth)

33760 RELAXATION OF IMPURITY-DEFECT COMPLEXES IN FLUORITE CRYSTALS. Crawford, J. H.; Kitts, E. L. Jr. (Univ. of North Carolina, Chapel Hill). pp 15-26 of Recent Advances in Science and Technology of Materials. Vol. I. Bishay, A. (ed.). New York; Plenum Publishing Corp. (1974).

Recent contributions to the understanding of the structure and the reorientation kinetics of various impurity-defect complexes in alkaline earth fluorides are summarized. For the most part the relevant investigations involve relaxation of electric polarization as revealed by the ionic thermo-current (ITC) method on CaF_2, SrF_2 and BaF_2 crystals doped with a variety of trivalent rare earth (RE^{3+}) ions. In the absence of contaminating oxygen the extra positive charge is compensated by an interstitial fluoride ion (F_i^-) which except at elevated temperature forms a complex with the RE^{3+}. In CaF_2 the dominant form of the complex as revealed by EPR and ITC is tetragonal with the F_i^- located in the nearest neighboring interstitial site (Type I complex). In BaF_2 the dominant form is trigonal with the F_i^- situated in a next nearest site along a ⟨111⟩ direction (Type II complex). In SrF_2 both Type I and Type II complexes are clearly evident in the ITC relaxation peak structure. In a crystal of CaF_2: Gd^{3+} treated to introduce oxygen the Type I relaxation at 131°K is replaced almost quantitatively by a new peak at 166°K. Comparison with EPR behavior reveals that the new peak is associated with the relaxation of the CaF_2: $Gd^{3+}O_i^{2-}F^-$ complex (Type T_I) which had been previously identified by ENDOR. The reorientation activation energy of 0.49 eV is more nearly comparable to that for Na^+–fluoride vacancy complexes in CaF_2 (0.5 eV) than to the activation energy for Type I complexes (0.42 eV). The reorientation activation energy for Type I complexes is found to be only slightly dependent upon the size of the rare earth ion, ranging from 0.38 eV for the smallest ion considered (Yb^{3+}), to 0.42 eV for U^{3+}, the largest. (auth)

33761 ^{237}Np MOESSBAUER PROBE EMBEDDED IN URANIUM DIOXIDE BY MEANS OF ^{238}U (γ/n) ^{237}U. Ohkawa, A. (Tohoku Univ., Sendai (Japan). Research Inst. of Mineral Dressing and Metallurgy); Shoji, T.; Matsui, K. Kakuriken Kenkyu Hokoku; 7: No. 1, 140-146(Jun 1974).

Uranium dioxide single crystals were irradiated by bremsstrahlung at energies of 35 to 65 MeV. Practically pure ^{237}U sources were prepared by the irradiations. The ^{237}Np 59.54 keV Mössbauer spectrum at 78°K shows unresolved structure extending over −1 to +1 cm/s. An annealing in hydrogen at 800°C removes the radiation damage effects to produce isolated Np^{+4} ion at normal uranium site, which is detected as a singlet line with an isomer shift value of +0.093 cm/s and line width of 0.15 cm/s. (auth)

33762 METHOD OF PREPARING A CERAMIC FUEL ELEMENT FOR NUCLEAR REACTORS. Hirose, Y.; Takeda, S. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1973-7031/B/. 16 Nov 1964. 3p. (In Japanese).

Ceramic fuel materials of high density are prepared by separating extra-fine powder sequentially by screening the powder particles having mean diameter larger than at least 5 microns, and filling the powder into fuel sheaths or containers by shaking or other means. The process of this invention can be applied to the manufacture of fuel elements which include packed uranium, thorium, plutonium and other nuclear fuel materials, and mixtures therewith. In one experiment, 20% by weight of fine powder particles under 325 mesh, 55% by weight of −8 + 10 mesh coarse powder particles, and 25% of −35 + 48 mesh medium particles of uranium dioxide which is crushed to 10.85 g/cm³ in bulk density are mixed and shaken down into a stainless tube with an inner diameter of 8 mm and a length of 500 mm. As a result of various mean diameter measurements of the fine powder particles, when the mean diameter of the fine particles after removal of the extra-fine particles was 3 microns, theoretical density was 82.7%; for 5.1 microns, 88.1%; and for 10 microns, 88.8%. High density packing can be attained when the mean diameter of the powder particles is greater than 5 microns. (JA)

33763 NEW PHASE TRANSITIONS IN NON-STOICHIMETRIC U_3O_{8-x} AT HIGH TEMPERATURES. II. Electrical Conductivity and X-Ray Study. Matsui, T.; Tsuji, T.; Naito, K. (Nagoya Univ. (Japan). Faculty of Engineering). J. Nucl. Sci. Technol. (Tokyo); 11: No. 8, 317-325(Aug 1974).

Electrical conductivity and x-ray diffraction studies on non-stoichiometric U_3O_{8-x} phase were carried out simultaneously in the range $765° \leq T \leq 995°C$ and $10^{-4} \leq Po_2 \leq 1$ atm. The plot of log σ vs. log Po_2 showed many refractions which corresponded with the phase transitions previously determined by thermogravimetry. Based on the data of both electrical conductivity and thermogravimetry, the non-stoichiometric defect structures of various U_3O_{8-x} phases are interpreted as consisting of singly charged oxygen interstitials and doubly charged oxygen vacancies. Some of the x-ray diffraction lines were found to undergo splitting with decreasing oxygen partial pressure. These splits are qualitatively discussed in reference to the out-of-step structure model. The mechanism of electrical conduction in the high temperature hexagonal U_3O_{8-x} phases is surmised to be the hopping of small polarons. (auth)

33764 ADSORPTION OF ARGON, NITROGEN, AND WATER VAPOR ON ZIRCONIUM OXIDE. Holmes, H. F.; Fuller, E. L. Jr.; Beh, R. A. (Oak Ridge National Lab., TN). J. Colloid Interface Sci.; 47: No. 2, 365-371(May 1974).

The adsorptive characteristics of zirconium oxide have been investigated by studying the adsorption of nitrogen, argon, and water. Surface properties were found to depend primarily on the amount of irreversibly adsorbed water retained by the sample. Water was found to irreversibly adsorb on zirconium oxide in amounts far in excess of that required for a classical chemisorbed monolayer. Weight loss for the sample between 25 and 500°C, in vacuum, was equivalent to 2.3 monolayers of chemisorbed water. Replacement of this water by adsorption from the vapor phase at 25°C became prohibitively slow after the irreversible adsorption of about 1.5 monolayers of water. In contrast to this, it was relatively easy to obtain reversible water vapor isotherms at 300 and 400°C. All three adsorbates showed that this sample of zirconium oxide has a pore system spanning the micro to macro size range. Irreversible adsorption of water caused a 20% decrease in the specific surface area as measured by nitrogen and argon. This reduction is real and occurs through the filling of micropores by irreversibly adsorbed water. Specific surface areas calculated from the water data suffer from the specificity of the interaction of water with the oxide surface and do not provide a true measure of the geometric area. (auth)

33765 INTERACTION OF NONSTOICHIOMETRIC MOLYBDENUM TRIOXIDE WITH CARBON. Elyutin, V. P.; Pavlov, Yu. A.; Polyakov, V. P.; Nesterenko, P. A. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 11, 5-8(1974). (In Russian).

It is shown that the calcination of MoO_3 power in vacuum at temperatures of 600 to 700°C and at various holding times is accompanied by a change in color and phase composition of the residue. The MoO_3 powder calcined in vacuum begins to react with carbon at a higher temperature than does the powder treated in an atmosphere of oxygen. A clear difference in rates of reaction with carbon is shown for oxide samples taken from the body of the powder and those taken from the surface. (SJR)

33766 TYPE OF CONDUCTIVITY OF ZIRCONIUM DIOXIDE STABILIZED WITH CALCIUM OXIDE. Liventsev, V. P.; Luzgin, V. P.; Frolov, A. G.; Yavoiskii, V. I. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 11, 14-18(1974). (In Russian).

A description is given of a unit for investigating the type of conductivity of solid oxide electrolytes by the emf method, and results are given of the effect of temperature and partial pressure of oxygen on the fraction of the ionic component of the conductivity of zirconium dioxide stabilized with calcium oxide. (tr-SJR)

33767 ANTIFERROMAGNETIC TRANSITION IN DYSPROSIUM DIHYDRIDE LOW-TEMPERATURE HEAT CAPACITY STUDIES. Bieganski, Z.; Opyrchal, J.; Drulis, M. (Inst. of Low-Temperature and Structure Research, Wroclaw). Phys. Status Solidi (a); 26: No. 1, 217-221(16 Mar 1975).

The low temperature specific heats of dysprosium dihydride, $DyH_{1.99}$, were measured in the range 1.8 to 22°K. Two specific heat anomalies were found: one sharp λ-type anomaly at T_N = (3.30 ± 0.03)°K and a rather broad second one at T_c = (4.5 ± 0.1)°K. The first anomaly is interpreted as due to an antiferromagnetic transition in $DyH_{1.99}$. The reason for the occurrence of the second anomaly is not clear as yet. The entropy change due to the magnetic contributions to the specific heat has been evaluated and interpreted. (auth)

33768 SEEBECK MEASUREMENTS AND THEIR INTERPRETATION IN HIGH-RESISTIVITY MATERIALS: THE CASE OF SEMICONDUCTING V_2O_3. Keem, J. E.; Honig, J. M. (Purdue Univ., Lafayette, IN). Phys. Status Solidi (a); 28: No. 1, 335-343 (16 Mar 1975).

A method for measuring and interpreting the Seebeck coefficient in high resistivity (≧10^5 Ωcm) materials is discussed; the technique is applied to pure V_2O_3 between 50 and 300°K. The results indicate that the low temperature phase of V_2O_3 is a band-type semiconductor. (auth)

33769 STIMULATED EMISSION FROM FERROELECTRIC $LiNbO_3$ CRYSTALS CONTAINING Nd^{3+} AND Mg^{2+} IONS. Belabaev, K. G.; Kaminskii, A. A.; Sarkisov, S. E. (Inst. of Crystallography, Moscow). Phys. Status Solidi (a); 28: No. 1, K17-K20(16 Mar 1975).

The possibility of increasing the distribution of Nd^{3+} ions in $LiNbO_3$ laser crystals was studied. Calculations were made showing that the addition of Mg^{2+} ions leads to an increase of the Nd^{3+} ion distribution coefficient in these crystals to a value of about 0.3. Data on spectral and laser generation measurements on single domain $LiNbO_3 : Mg^{2+} - Nd^{3+}$ crystals are listed. (JRD)

33770 OPTICAL ABSORPTION AND LATTICE DEFECTS INDUCED BY NEUTRON IRRADIATION AND HEAT TREATMENT IN ZnS CRYSTALS. Matsuura, K.; Tsurumi, I.; Takeda, F. (Tottori Univ., Japan). Phys. Status Solidi (a); 28: No. 1, 379-385(16 Mar 1975).

Measurements are made on optical absorption from 350 to 2500 nm at 77°K of ZnS crystals irradiated by fast neutrons at room temperature and of those fired in a zinc or sulfur vapor at 1100°C. It has been found that neutron irradiation produces photoinsensitive 2.7 and 1.75 eV bands in addition to the 3.5, 3.2, 2.9, and 2.3 eV bands reported previously, and that the firing in zinc vapor produces new photosensitive 3.2, 2.7, and 1.75 eV bands. All of the six bands produced by neutron irradiation are also produced by the firing in zinc vapor. However these bands can not be produced by the firing in sulfur vapor, which produces four bands different from those induced by the zinc firing. It is proposed that the 3.5, 3.2, 2.7, and 1.75 eV bands are related with sulfur vacancies and that the 2.7 and 1.75 eV bands are due to hole transitions. (auth)

33771 RADIATION EFFECTS IN OXIDE FERRIMAGNETS. Chukalkin, Yu. G.; Goshchitskii, B. N.; Dubinin, S. F.; Sidorov, S. K.; Petrov, V. V.; Parkhomenko, V. D.; Vologin, V. G. (Inst. of Metal Physics, Sverdlovsk, USSR). Phys. Status Solidi (a); 28: No. 1, 345-354(16 Mar 1975).

The influence of neutron radiation on the value of an average molecular magnetic moment n_B, the Curie temperature T_C, and the structural parameters of mixed Mn-Zn and Ni-Zn ferrites was studied. It is shown by methods of structural neutronography and small-angle diffuse magnetic neutron scattering that essentially irreversible changes of all quantities measured experimentally observed at irradiation doses higher than 10^{18} cm^{-2} are caused mainly by the creation of disordered phase microregions during irradiation. The appearance of such regions is assumed to be caused by the so-called displacement spikes. (auth)

33772 STUDY OF THE COMPOSITION, STRUCTURE, AND MORPHOLOGY OF THE STRENGTHENING PHASE IN Nb-Zr-C ALLOY. Khandarov, P. A.; Luk'yanov, A. N.; Usikov, M. P.; Arakelov, A. G. Izv. Akad. Nauk SSSR, Metal.; No. 1, 211-214 (1975). (In Russian).

A study was made of the morphology and type of distribution of carbide phases in the alloy Nb-1% Zr-0.1% C after various thermal treatments. After annealing at 1450 and 1600°C the carbide Nb_2C having an orthorhombic lattice is formed in the alloy, and after quenching from 1900°C the carbide Nb_2C with a hexagonal lattice is formed. Large carbide crystals of the type MC with a bcc-lattice are encountered in small amounts. (SJR)

33773 PRESSURE-TEMPERATURE AND TEMPERATURE-COMPOSITION PHASE DIAGRAMS FOR THE ZIRCONIUM-HYDROGEN SYSTEM. Levinskii, Yu. V.; Andrievskii, R. A.; Boiko, E. B. Izv. Akad. Nauk SSSR, Metal.; No. 1, 182-185(1975). (In Russian).

Characteristic isobaric and isothermic cross-sections are considered for the Zr-H system. These p-t and t-C diagrams may be useful in analyzing the behavior of zirconium hydrides over a wide interval of pressures and temperatures. Data are lacking on the behavior of alloys at temperatures above 1000 to 1200°C and pressure above 10 atm. (SJR)

33774 SOLIDUS TEMPERATURE OF ZIRCONIUM CARBIDE IN THE REGION OF HOMOGENEITY. Zotov, Yu. P.; Kotel'nikov, R. B. Izv. Akad. Nauk SSSR, Metal.; No. 1, 179-181(1975). (In Russian).

The solidus temperature of zirconium carbide was determined in the region of homogeneity. It is shown that zirconium carbide of the composition $ZrC_{0.87}$ has the maximum solidus temperature of 3810 ± 70°K. Zirconium carbide of the composition $ZrC_{0.98}$ melts at the melting temperature of the eutectic ZrC + C (3200 ± 50°K). (SJR)

33775 EFFECT OF HAFNIUM NITRIDE ADDITIONS ON THE STRUCTURE AND PROPERTIES OF NIOBIUM. Grigorovich, V. K.; Sheftel, E. N.; Usmanova, G. Sh. Izv. Akad. Nauk SSSR, Metal.; No. 1, 170-178(1975). (In Russian).

Alloys of niobium alloyed with hafnium and nitrogen are heterophase containing precipitates of dispersed nitrides of niobium and hafnium, and oxynitride phases. The type of precipitating phase and its morphology depend on the alloy composition and mode of thermal treatment. The structure and strength of the alloys are explained as a function of thermal treatment. Within the limits of the compositions under study the main role in strengthening of niobium belongs to hafnium nitride (HfN). Alloys of optimal composition after the corresponding thermal treatment in short-term and long-term strength at 1200°C approach industrial high-content alloys in which a solid-solution mechanism of strengthening with molybdenum and tungsten is realized. (SJR)

33776 INTERACTION OF SILICIDE AND BOROSILICIDE COVERINGS WITH A TUNGSTEN BACKING. Burykina, A. L.; Dzyadykevich, Yu. V.; Sosnovskii, L. A.; Elik, A. P.; Gorskii, V. V. Izv. Akad. Nauk SSSR, Metal.; No. 1, 153-157(1975). (In Russian).

As a result of investigating the kinetics of formation and the structure of intermediate phases during the interaction of silicide and borosilicide coatings with a tungsten backing in the temperature interval of 1400 to 1600°C for a period of 10 hours in vacuum it was established that: 1) in the silicide coating in this temperature interval the tungsten disilicide WSi_2 is smoothly converted to the lower silicide W_5Si_3; after holding 10 hours at 1600°C the coating consists wholly of the lower silicide W_5Si_3; 2) in the borosilicide coating only the phase $W_3(B, Si)_3$ forms and grows at the phase boundary of WSi_2 and α-WB. The presence of a ternary bond $W_3(B, Si)_3$ significantly slows down the conversion of tungsten disilicide to the lower silicide phase. (SJR)

33777 PHASE EQUILIBRIA IN THE HAFNIUM-COBALT-BORON, HAFNIUM-NICKEL-BORON, AND NIOBIUM-MANGANESE-BORON TERNARY SYSTEMS. Kuz'ma, Yu. B. Visn. L'viv. Derzh. Univ., Ser. Khim.; No. 14, 20-24(1972). (In Ukrainian).

X-ray phase analysis was used to construct the equilibrium phase diagrams of (i) the Hf-Co-B, (ii) Hf-Ni-B, and (iii) Nb-Mn-B systems. In (i) the compounds $Hf_5Co_{11}B_6$ and $HfCoB_2$ exist at 1000°C. At 800°C the ternary τ-phase of variable composition $Hf_{2-4.3}Ni_{21-18.7}B_6$ occurs in (ii) with the lattice constant, a, increasing from 10.590 to 10.664 Å as the Hf content increases. No appreciable solid solutions or ternary compounds were detected in (iii) at 800°C, but in the Nb-Mn system with Nb 50 to 55 at.-% a new compound was found that exists in equilibrium with $NbMn_2$ and Nb. (Referativnyi Zh.)

Metals and Alloys

Refer also to abstracts 32823, 33715, and 35136.

33778 (ORNL-5104) MECHANICAL PROPERTIES TEST DATA FOR STRUCTURAL MATERIALS. Quarterly Progress Report for Period Ending January 31, 1975. Hill, M. R. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 359p. AT.

Test data on heat resisting alloy structural materials are presented. These data were obtained in research conducted at Argonne National Laboratory Hanford Engineering Development Laboratory, Naval Research Laboratory, Oak Ridge National Laboratory, Westinghouse Advanced Reactors Division, University of Cincinnati, and General Electric Company. (JRD)

33779 (WANL-TNR-033) MATERIALS FOR DESIGN, NERVA NUCLEAR SUBSYSTEM. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1962. 246p. Dep. NTIS $15.50.

Declassified 4 Sep 1973.

Materials for design of the NERVA reactors are discussed from the point of view of background on behavior, design requirements and analysis of known property data. Data are presented on material properties as a function of temperature when known. Typical properties and random spread are included where possible. There are many gaps in existing knowledge and much effort on materials will be required to meet design needs. (auth)

33780 (WANL-TR-6692) TRIP REPORT OF PBRF. DeMastry, J. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 13 Jan 1972. 3p. Dep. NTIS $4.00.

Discussions of A-286 corrosion, thermal diffusivity capsules, cryoloop irradiations, and graphite tensile testing are presented. (JRD)

Corrosion and Erosion

Refer also to abstracts 32496, 32975, 33716, 34047, 35138, 35171, and 35172.

33781 (ACF-411-251) CORROSION STUDY ON MATERIALS USED IN THE PRIVY ROOF MOUNTED SHIELD. Hanks, J. G. (ACF Industries, Inc., Albuquerque, N. Mex. (USA)). 9 Aug 1965. 13p. Dep. NTIS $4.00.

Results of corrosion tests conducted on materials used in the Privy Roof Mounted Shield are presented. The tests were conducted to determine quantitatively if galvanic corrosion occurred between the metallic alloys chosen for the shield when subjected to temperatures and water conditions approximating expected conditions during use at the Nuclear Reactor Development Station (NRDS), Nevada. It was found that the small weight changes caused by corrosion are inconclusive when the weight loss due to cleaning and the weighing tolerance are considered. The effect of the cleaning process was approximated when an uncorroded aluminum test specimen (1/4" thick disk) was subjected to cleaning. Its weight loss was approximately 0.033 gram. Weight losses due to corrosion during the ten-day tests were not sufficient to offset the inherent weight losses in cleaning and weighing. (auth)

33782 (AECL-4936) IODINE INDUCED CRACKING OF ZIRCALOY FUEL CLADDING: A REVIEW. Cox, B.; Wood, J. C. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). 1974. 47p. AECL.

The evidence available on the factors affecting the stress corrosion cracking (SCC) of the Zircaloys in iodine at elevated temperatures is summarized. Cold work and irradiation hardening increase the susceptibility to SCC but other factors such as surface oxide conditions, crystallographic texture and residual stresses can also have appreciable effects. Cracking takes place in three steps. First the surface oxide film must be rendered previous to iodine by either chemical or mechanical breakdown. Second, the chemical conditions must be such as to generate a sharp notch (rather than a pit) beneath the surface film. This process involves chemical removal of zirconium as a volatile product, and often proceeds via an intergranular path. Third, crack propagation is commonly predominantly transgranular and appears to be best explained by an adsorption-type mechanism which can proceed at all temperatures from room-temperature up to 500°C with little change in velocity. For smooth specimens the occurrence of SCC will be determined by the success of the first two steps in initiating a crack. Evidence from fuel element testing together with the results of laboratory tests are now sufficient to permit the definite conclusion that fuel failures that occur after the sudden uprating of fuel elements can be caused by stress corrosion cracking. (auth)

33783 (RD/B/N-2980) EFFECT OF CARBON TRANSFER BETWEEN STAINLESS (AISI 316) AND FERRITIC (2¼Cr, 1Mo) STEELS IN SODIUM. Charnock, W.; Cordwell, J. E.; Gwyther, J. R.; Hobdell, M. R. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1974. 27p. (FRDC/CEWP/P-(74)16; FRDC/FEWP/CPN-302; FRDC/MWP/P-(74)16). Dep. NTIS (US Sales Only) $4.00.

Carbon activity changes at 913°K in sodium containing the candidate CFR alloys AISI 316 and 2¼Cr-1Mo steel were monitored using an electrochemical cell. In the first 100 hours of exposure, a large activity change from ~1 to 0.16 occurred. In a further 700 hours, the activity fell steadily but slowly to 0.11. Discontinuities on the activity/time curve suggest that the rate of carbon transfer between these steels is not controlled simply by a single diffusion process. The effect of sodium exposure upon the microstructure and upon some mechanical properties of the steels was examined. A steep gradient of grain boundary carburization was found to extend to the midsection of the 760μm-thick AISI 316 specimens. There was uniform decarburization of the 2¼Cr-1Mo steel. Accurate weight gain measurements confirmed that appreciable carbon transfer had occurred. Such effects would be expected to cause appreciable deterioration in the long-term creep properties of these materials. However, the effects of these changes on short term tensile test properties and upon microhardness could not, in general, be detected. An exception was a single-room temperature tensile test on an AISI 316 specimen in which a moderate reduction in ductility occurred in association with some intergranular cracking. (18 figures) (auth)

33784 (RN-TM-0312) METALLURGICAL INVESTIGATION OF HYDROGEN PREHEATER TUBE FAILURE. Lamvermeyer, D. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1966. 34p. Dep. NTIS $4.75.

Eleven stainless steel tubes in the north arch of the gaseous hydrogen preheater radiant section ruptured during a scheduled turbopump test run. Failure occurred at 760 psi pressure and 1250°F tube-wall temperature. Subsequent hydrogen combustion overheated the preheater to 1600 to 1800°F for 3 to 4 minutes. Two of the eleven tubes ruptured with coarse, non-elongated brittle fracture causing the remaining tubes to rupture by localized overheating with decrease of material strength. The investigation was conducted to determine (a) the cause of failure, (b) extent of damage from overheating, and (c) actions necessary to qualify the preheater for operation. The primary fracture was caused by zinc contamination which penetrated the grain boundaries under elevated temperature conditions. Cracks were progressively formed causing reduction of tube wall thickness and rupture. The source of zinc contamination could not be located. Overheating damage was indicated by measuring the OD of all tubes and revealed that tubes numbered 31 through 40 and 99 in the north arch were bulged. The remaining tubes were not adversely affected by the overheating as evidenced by satisfactory elevated and room temperature tensile, sensitization, degradation and bulge test results. It is recommended that all tubes be inspected by shear-wave ultrasonic tests for detection of cracks prior to the initial test run and periodically thereafter, that the preheater be leak tested at a pressure equivalent to one-half of the material yield strength, and that the sine-wave spacers be independently supported to prevent sagging during future heater operations. (auth)

33785 (SAND-74-0270) ENVIRONMENTALLY ASSISTED CRACK GROWTH IN HIGH STRENGTH STEELS. Munford, J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jan 1975. Contract AT(29-1)-789. 16p. Dep. NTIS $4.00.

Results of stress corrosion cracking tests on high strength steels are presented. Materials tested include alloys 18 Ne 200, 18 Ni 250, Almar 362, and HP 9-4-20. Test data are presented graphically. (JRD)

33786 (WANL-TME-1730) COMPARISON OF THE EROSION POTENTIAL FOR A POTASSIUM VAPOR TURBINE AND A CESIUM VAPOR TURBINE. Pouchot, W. D. (ed.). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 9 Feb 1968. 143p. Dep. NTIS $10.25.

For Jet Propulsion Lab., Pasadena, CA.

An analytical model of wet vapor turbine blade erosion developed previously for steam turbines was used to examine two alkali metal working fluid space turbine conceptual designs. These turbines are a six-stage potassium working fluid turbine and a two-stage cesium working fluid turbine. For both turbines the design shaft output is 1 MW at 24,000 rpm. The operating conditions for both turbines are approximately the same and the turbines are designed for comparable duty. To perform the alkali metal turbine erosion analysis, changes in the steam erosion model were required to account for differences in operating conditions and fluid properties. Some of these changes have not been experimentally verified at this time. Subject to the foregoing statement, the calculated results indicate little, if any, erosion of the classical steam turbine type for either turbine. On a comparative basis, the possibility of physical material removal by drop impact is much less in the cesium turbine than in the potassium turbine. In steam turbines the collected moisture reaching the turbine casing is periodically removed (through slots or other means) from the turbine flow path. It is recommended that this procedure be followed in potassium metal vapor turbines. The casing liquid flows will almost certainly be in a "dispersed flow" region for both turbines. It is expected that such a "dispersed flow" will contain large enough drops in the potassium turbine to cause damage to blade tip seals, shrouds, and blade tips. From analytical results of an analysis of material removal by chemical dissolution, it is concluded that material losses will be substantial in both turbines if the blades are made from gas turbine superalloy-type materials such as Udimet 700. A dissolution analysis for the refractory materials such as TZM is inconclusive as to the exact level of material loss, but the level is indicated to be substantially below that of the gas turbine superalloys. (auth)

33787 (WANL-TMI-1441) OXIDATION OF METALS AND ALLOYS AT HIGHER TEMPERATURES. Pinchok, R. N. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1965. 26p. Dep. NTIS $4.50.

The preliminary data obtained in the study of titanium oxidation is in good accord with that found by other investigators. It has been shown that the oxidation rate of titanium is dependent on both the temperature and gas pressure. A unique feature of the study is the observation that at 1300 to 1400°C the oxidation follows a logarithmic rate. Since re-entry temperatures may reach these temperatures, this phenomena is truly of an important nature. A closer study of this temperature region and the dependence of gas pressure must be made. It has also been noted that breaks occur in the oxidation rates. These breaks seem to occur after a critical amount of oxide is formed on the sample. There is a strong dependence on temperature and very little dependence on pressure. This is important, in that, a critical amount of oxide formed will act as a protective coating and inhibit ablation. (auth)

33788 (WARD-NA-3045-18) SODIUM TECHNOLOGY PROGRAM COMPONENT MATERIALS COMPATIABILITY QUARTERLY PROGRESS REPORT FOR PERIOD ENDING OCTOBER 31, 1974. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Mar 1975. Contract AT(11-1)-3045. 14p. AT.

Interstitial transfer run ITF-5 was completed. Corrosion data obtained from the 2000-hour exposure showed that stainless steel cladding samples located at the primary heater outlet (1360°F, zero L/D) and at the end of the isothermal section (1350°F, 260 L/D) were in good agreement with results obtained from Run ITF-4, with values measured at 1.04 and 0.58 mpy, respectively. An examination of nitrogen distribution in ITF-3 suggested that, contrary to prior assumptions, nitrogen loss would in general be insignificant. Metallurgical analysis of primary heater samples from ITF-4 provided evidence of major alloy element depletion of the sodium exposed surfaces. Although carbide depleted zones were clearly observed, it was noted that this did not necessarily reflect carbon depletion to any great extent, but was merely the consequence of some carbide dissolution resulting from the local change in alloy composition. Sodium pre-exposure of six Inconel 718 mechanical property test samples was initiated. The samples, exposed to 1000°F sodium with a velocity of 6.5 fps in the hot leg of the loop, will operate for 2000 hours. Thermal aging (vacuum) of identical samples at 1000°F for 2000 hours was completed. Solution-annealed Type 316 stainless steel plate material was received and is being fabricated into mechanical property test samples. The samples will be used to evaluate the effects of a sodium environment on the properties. Hardware for sodium pre-exposure and vacuum aging of the samples prior to testing is being fabricated. (auth)

33789 CORROSION OF N70M27F (EP 496) NICKEL-MOLYBDENUM ALLOY IN HYDROCHLORIC ACID CONTAINING FERRIC CHLORIDE. Gadasina, L. Yu.; Meshcheryakova, I. D.; Kashcheeva, T. P.; Rutkovskii, M. L. Prot. Metals (USSR) (Engl. Transl.); 10: No. 4, 375-376(1974).

Translated from Zashchita Metallov; 10: No. 4, 408-410(1974).

Results of tests to determine the corrosion resistance of this alloy in 15, 22, and 30% HCl solutions containing 0.003 to 1.1% $FeCl_3$ at 20 to 100°C are presented. Corrosion data are presented in tables and analyzed. (JRD)

33790 CORROSION MENACE IN THE NUCLEAR FIELD. Roux, A. J. A. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Power Plant South. Afr.; 15: No. 14, 15, 19 (Nov 1974).

Meticulous attention to corrosion control is one of the many reasons why the nuclear energy industry has a fine safety record. Detailed examples are cited showing the dangers of corrosion in the nuclear field. (ATOMINDEX)

33791 EXPLOSIVE BEHAVIOR OF URANIUM-BASE NIOBIUM ALLOYS DURING METALLOGRAPHIC PREPARATION. Jackson, R. J. Metallogr. Rev.; 2: No. 1, 11-14(Mar 1973).

Uranium-base Nb alloys in certain heat treated conditions can explode violently during or after immersion in strong oxidizing acids. The explosive behavior of U-base Nb alloys after immersion in nitric acid is characterized. The explosive behavior is related to a finely divided, two-phase microstructure and to a high C content. In the first case, the nitric acid selectively attacks the α-U phase leaving behind a finely divided, Nb-rich γ phase which can oxidize with explosive violence. In the second case, niobium carbide inclusions accumulate at the surface and are likewise subject to rapid oxidation. The most explosions occur with slow-cooled, slab-case, high-C alloys having a casting scale of UO and UO_2. Nitric acid dissolves the UO and UO_2 casting scale and leaves behind a reactive surface layer of finely divided-γ-U, Nb_2C, NbC, and $UO_2(NO_3)_2 \cdot 6H_2O$. When this wet or dry layer is sparked or struck, a violent decomposition occurs which rapidly produces large quantities of gases and heat, and leaves behind a residue of UO_2 on the surface of the metal. (Metals Abstr.)

33792 BINDING ENERGIES IN CUBIC METAL SURFACES. Jackson, D. P. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 1-5 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

Surface binding energies are calculated using Morse potentials for the (100), (110), and (111) surfaces of seven fcc and 9 bcc metals. Estimates are made for a further seven metals. Surface relaxation effects are included and their effect discussed. The surface binding energies are found to be greater than the sublimation energy per atom of the solid. Qualitative arguments are proposed to explain the ordering of binding energies between crystal faces. Comparison with experimental data for the adsorption energies of tungsten atoms on tungsten crystal faces indicates the plausibility of the calculated values. (5 tables) (auth)

33793 CORROSION PROBLEMS WITH WELDED JOINTS OF HIGH ALLOYED STEELS. Herbsieb, G. (Mannesmann-Forschungsinstitut G.m.b.H., Duisburg (F. R. Germany)). Werkstattstechnik; 26: No. 4, 126-127(1974). (In German).

From lecture presented at the DVS-Bezirksverband; Duesseldorf, F. R. Germany (12 Mar 1973). 6 figs.

Descriptions are given of failures caused by pit corrosion, transcrystalline stress corrosion cracking and intercrystalline corrosion. Possible methods for preventing such problems are discussed. (GE)

33794 ELECTRON STIMULATED DESORPTION: PRINCIPLES AND RECENT DEVELOPMENTS. Menzel, D. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.). Surface Sci.; 47: No. 1, 370-383(Jan 1975).

From 3rd international symposium on surface physics; Utrecht, The Netherlands (26 Jun 1974).

A survey is given of the basic experimental findings in electron stimulated desorption and of the accepted theoretical model for their explanation. As an example for the test of the theory, the isotope effect in ESD of hydrogen on tungsten surfaces is described, which shows excellent agreement with the predictions of the model. The use of ESD as a surface probe is exemplified with recent work on hydrogen adsorption states on tungsten; the need for generalization of the one-dimensional model to three dimensions becomes clear in this case. Recent developments in theory (a quantum-mechanical treatment of the process) and experiment (promising measurements of the angular distribution of ionic ESD) are shortly discussed. (auth)

33795 HIGH TEMPERATURE OXIDATION OF URANIUM ALLOYS. Cathcart, J. V.; Pawel, R. E.; Petersen, G. F. (Oak Ridge National Lab., TN). pp 669-674 of Proceedings of the Fifth International Congress on Metallic Corrosion. Houston, TX; National Association of Corrosion Engineers (1974).

From 5th international congress on metallic corrosion; Tokyo, Japan (21 May 1972).

The high temperature oxidation characteristics of several U alloys containing Nb, Zr, and Mo were studied. In all cases, oxide formation involved the generation of large stresses in the oxide, and the magnitude of these stresses was estimated to be 10^4 psi. Oxidation of these alloys proceeds via anion diffusion, and the stresses arise because of the need to accommodate the volume expansion accompanying the oxidation of U. The existence of these stresses activates several stress relief mechanisms including the plastic deformation of both oxide and metal and a flow of vacancies to the oxide-metal surface. (auth)

33796 REACTION RATE BETWEEN DILUTE IODINE VAPOR AND STAINLESS STEEL IN HIGH-TEMPERATURE ARGON STREAM. Nishio, G.; Kitani, S.; Ito, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment. J. Nucl. Sci. Technol. (Tokyo); 11: No. 8, 339-344(Aug 1974).

Considering the three steps of (1) deposition of iodine on the stainless steel, (2) formation of metallic iodides, on the metal surface and (3) sublimation of the iodides into the stream, the reaction rate between dilute iodine vapor and stainless steel in high-temperature argon stream was obtained. The rate was determined by shallow-bed method, using a thin bed of granular stainless steel. The apparent rate constant obtained from the reaction rate was expressed in reference to unit surface area of the stainless steel grains. The rate of deposition of radioiodine on the stainless steel was found to correspond to less than 10% of the concentration of iodine in the stream. (auth)

33797 EFFECTS OF THE COMPOSITION AND STRUCTURE OF ALLOY ON THE STRESS CORROSION CRACKING OF CHROMIUM–NICKEL STAINLESS STEEL IN HOT WATER. Ishihara, T.; Shimizu, Y.; Ito, G. (National Research Inst. for Metals, Tokyo (Japan)). Kinzoku Zairyo Gijutsu Kenkyusho Kenkyu Hokoku; 17: No. 1, 24-31(Feb 1974). (In Japanese).

The effects of the composition and structure of chromium–nickel steels on the susceptibility to the stress corrosion cracking in hot water containing 600 ppM chlorine ions at 300°C were studied. Alloys tested were 18% Cr 0%–50% Ni steel, and 19Cr–9Ni steel containing either Al, Si, V, Mo, or Re. Also tested were 19Cr–9Ni steel and 18Cr–3–50Ni steel, to which impurities such as C, Mn, Si, P, N, Mo, and Cu were added. The object of the testing was to examine the effect of alloying elements, and to study impurity effects. The experiment revealed that susceptibility to stress corrosion cracking of highly pure alloys depends on the amount of ferrite in the structure of steel. When the amount of ferrite was 5%–10% and 40%–50%, the alloys were susceptible to stress corrosion cracking. However, when the amount of ferrite was below 5%, 10%–40%, and near 100%, the alloys were insusceptible to it. The susceptibility to stress corrosion cracking may be ascribable to hydrogen produced in the corrosion process. The chemical composition has some influence on the susceptibility to fracture. The steel containing less phosphorus or carbon is resistant to stress corrosion cracking even in magnesium chloride solution as well as in hot water. (JA)

33798 THERMODYNAMIC CHARACTERISTICS FOR THE INTERACTION OF NITROGEN WITH NIOBIUM ALLOYS AT HIGH TEMPERATURES. Elyutin, V. P.; Mozzhukhin, E. I.; Maksimov, D. G. Izv. Akad. Nauk SSSR, Metal.; No. 1, 115-121 (1975). (In Russian).

Thermodynamic characteristics were obtained for the interaction of nitrogen with solid, niobium solutions, alloyed with 1 and 2 at.% Ti (Zr, Hf), in the temperature interval of 1600 to 1800°C. Calculations were made on the enthalpy and entropy for the transfer of nitrogen from the gas phase to a site in the solid alloyed solution, where one of the closest neighboring atoms of nitrogen is an atom of the alloying element. In the solid niobium solution the chemical affinity of Ti, Zr, and Hf for nitrogen varies in the same sequence as the chemical affinity of the IV A group of elements for nitrogen varies under standard conditions. (SJR)

33799 STRUCTURE AND A NUMBER OF PROPERTIES OF THE NITRIDE LAYER ON IRON–MOLYBDENUM ALLOYS. Belotskii, A. V.; Nikitina, O. V.; Permyakov, V. G. Izv. Akad. Nauk SSSR, Metal.; No. 1, 112-114(1975). (In Russian).

A study was conducted on the sequence of formation of nitride phases in the diffusion layer during nitriding iron alloyed with molybdenum (in concentrations < 3 at.%) in the temperature interval from 450 to 1000°C. In the temperature interval where the α-solid solution exists there are substantial phase and structural changes during formation of a nitrided ferrite and an excess gamma-phase. An estimate is given of the content of nitrogen in the molybdenum-alloyed ferrite, and quantitative relations were established between the nitrogen content and the content of molybdenum in the iron, and also the temperature of the process. The high hardness of the diffusion layer, which is obtained in the pre-eutectoid interval of temperatures, is determined mainly by the degree of supersaturation of the molybdenum-alloyed α-phase with nitrogen, and the tendency of this phase to dispersion hardening, and also by the presence of complex nitride phases having a bcc-lattice in the layer. Nitriding of these alloys at temperatures above 750°C leads to significant intensification of the process, but the nitriding is accompanied by the formation of layer defects in the form of pores which significantly lower its strength. (SJR)

33800 STUDY OF NIOBIUM NITRIDING. Prokoshkin, D. A.; Vasil'eva, E. V.; Tret'yakov, V. I.; Voronova, T. A. Izv. Akad. Nauk SSSR, Metal.; No. 1, 107-111(1975). (In Russian).

Nitriding of niobium was carried out at 600 to 800°C in various structural states. The structure of the diffusion layers was investigated by metallographic and x ray studies and by the change in microhardness. It is shown that the diffusion of nitrogen in niobium at 600 to 800°C occurs with the formation of nitride phases. The outer layer consists mainly of the nitride NbN (WC type) of significant thickness; under this layer is a hexagonal nitride Nb_2N of slight thickness, while the lower layer is a solid solution of nitrogen in niobium with nitride inclusions. The kinetic and energy parameters of the nitriding process were determined. It is shown that the surface saturation of niobium with nitrogen follows a parabolic law. This behavior indicates that the factor controlling the process is the diffusion of nitrogen in niobium. The diffusion coefficients of nitrogen in annealed and deformed niobium were calculated. Analytical expressions were determined for the temperature dependencies of these coefficients. Crystal structure defects created by preliminary cold plastic deformation lead to a decrease in the diffusion coefficient and to an increase in the diffusion activation energy of nitrogen in niobium. The slow down of nitrogen diffusion in deformed niobium is apparently caused by the interaction of atoms of this element with crystal structure defects, and above all with dislocations. From experimental data a determination was made of the binding energy of nitrogen atoms with dislocations, the value of which was ~9.0 kcal/mol. This value agrees well with the binding energy predicted from dislocation theory. (SJR)

33801 HIGH-TEMPERATURE OXIDATION OF ZIRCONIUM AND HAFNIUM IN AIR. Voitovich, R. F.; Golovko, E. I.; D'yakonova, L. V. Izv. Akad. Nauk SSSR, Metal.; No. 1, 75-79(1975). (In Russian).

A study was carried out of the oxidation process on zirconium and hafnium at temperatures of 600 to 1200°C in air. Features of slag formation on Zr and Hf were investigated by the following methods: kinetic, metallographic, micro x ray, x ray phase analysis, and change in microhardness of oxidized sample with depth. The microstructural analyses showed that ZrN first forms on an internal phase boundary at about 600°C and that the ZrN then is oxidized to a more stable, cubic ZrO_2 layer. The new phases create stresses on the internal boundaries, and are one of the reasons for the formation of cracks and cavities at the oxide-metal boundary. Formation of an oxide layer on Hf is apparently caused by the selective oxidation of Hf at 800 to 900°C. Impurity diffusion along grain boundaries was noted. At higher temperatures of 1000 to 1200°C, it is noted that the monoclinic form of HfO_2 is transformed to the tetrahedral form. (SJR)

Preparation and Fabrication

Refer also to abstracts 33714, 33717, 33722, 34192, 35603, and 35604.

33802 (ACF–412-253) METALLURGICAL CHARACTERISTICS OF WELDMENTS IN 0.750-INCH-THICK 6061 ALUMINUM. Kish, A. J.; Erickson, R. B. (ACF Industries, Inc., Albuquerque, N. Mex. (USA)). 14 Aug 1965. 30p. Dep. NTIS $4.50.

The weldments under various conditions were evaluated to select the most promising heat treatment. This treatment was compared with as-welded properties. Techniques were established for the production processing of welded 6061 aluminum. (DLC

33803 (BM-RI-7958) STRENGTHENING MOLYBDENUM BY POWDER METALLURGICAL INTERNAL OXIDATION OF $ZrMo_2$. O'Brien, W. L.; Blickensderfer, R. (Bureau of Mines, Albany, Oreg. (USA). Albany Metallurgy Research Center). 1974. 14p. Albany Metallurgy Research Ctr., OR.

Molybdenum alloys with good strength properties at elevated temperatures were produced by the powder metallurgical internal oxidation method previously applied to tungsten and known as oxyreaction strengthening. Commercial molybdenum powders were blended with 0 to 10% of a reactive powder, $ZrMo_2$. The effects of composition, blending procedure, and sintering conditions on strength properties at elevated temperatures were studied. Strengthening was attributed to zirconium in solid solution with molybdenum and to the presence of submicrometer particles of ZrO_2. Several alloys had tensile strength and stress-rupture properties comparable with those of the best commercial alloys. The maximum tensile strengths obtained were 92 kpsi at 1,200°C and 53 kpsi at 1,316°C. The maximum stress-rupture life at 30 kpsi and 1,200°C was 145 hours. (auth)

33804 (MCIC-74-17) PROCEEDINGS OF THE 1973 SYMPOSIUM ON ELECTRODEPOSITED METALS FOR SELECTED APPLICATIONS, COLUMBUS, OHIO, NOVEMBER 14–15, 1973. (Battelle Columbus Labs., Ohio (USA)). Apr 1974. 124p. (CONF-731165-). Metals and Ceramics Information Center, Battelle Columbus Labs., Ohio 43201.

Papers presented at the symposium are documented. Included are papers on trochoid coatings for rotary engines, environmental effects on Au electroplates, properties of Al–Mn alloy electrodeposits, properties of electrodeposited Ni foil, effects of Ni plating on hardened steel, electrodeposition of dispersion strengthened alloys, Ni–Co deposits for electrojoining applications, nondestructive testing of rocket thrust chambers, Ni–B electroless coatings, properties of ultrathin Cr–CrO_3 coatings, properties of electrodeposits produced at rates >1 mil/min, and comparison of vacuum-deposited and electrodeposited coatings. (JRD)

33805 (TID/SNA-1464) CAST ALUMINUM ALLOY JACKET MATERIALS DEVELOPMENT PROGRAM FOR THE NERVA NOZZLE. Second Summary Status Report for the Period 4–30 November 1962. Inouye, F. T. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov. 1962. 45p. Dep. NTIS $5.25.

Four small experimental brazed tube bundles were electroplated with gold, nickel, silver, and copper, and then diffusion-

treated in hydrogen. They were jacketed using A-356 aluminum alloy by a static melt consolidation process, and examined. Gold and silver were observed to be most effective in forming a metallurgical bond between the braced tube bundle and cast aluminum alloy jacket. Gold is considered superior to silver as the primer on the basis of observed bonding continuity. Metallurgical bonding was not evident between those bundles primed with nickel and copper respectively and their cast aluminum alloy jackets. (auth)

33806 (TRG-Report-2642(S)) ALLOY 800 WELDING EXPERIENCE AT THE AEA SPRINGFIELDS LABORATORIES. Taylor, A. F. (UKAEA Reactor Group, Springfields). 2 Dec 1974. 9p. (CONF-740988-2). Dep. NTIS (US Sales Only) $4.00. UK.

From materials conference on status review of alloy 800; Reading, Berkshire, UK (25 Sep 1974).

TIG welding trials of Alloy 800 tube to tube-plate joints and tube to tube butt joints, using a computer controlled welding manipulator, have given good results with Type 316 SS and it is possible to produce welds of reasonable shape with mild steel overlaid with Inconel 82. Attempts to produce joints with $2\frac{1}{2}$ Cr 1 Mo and Inconel plates were not successful. (auth)

33807 (WANL-TR-6686) TRIP REPORT TO LOS ALAMOS SCIENTIFIC LABORATORY, LOS ALAMOS, NEW MEXICO. Pereira, A. J.; Ruyak, F. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Dec 1971. 4p. Dep. NTIS $4.00.

Techniques used to fabricate NERVA fuel elements are reviewed. Information is included on continuous extrusion, high temperature induction furnaces, machining operations, and processing of machine cuttings. (JRD)

33808 TEKHNOLOGIYA REDKIKH METALLOV V ATOMNOI TEKHNIKE. (Technology of Rare Metals in Atomic Industry). Yagodin, G. A.; Sinegribova, O. A.; Chekmarev, A. M. Moscow; Atomizdat (1974). 344p.

A presentation is made of the technology of rare metals finding wide use in atomic industry. Information is included on zirconium, hafnium, lithium, beryllium, rare earths, niobium, tantalum, and vanadium. The material is arranged according to typical processes such as beneficiation and mineral treatment, ion-exchange, extraction, thermic reduction, and electrolysis. A presentation is made of the physical-chemical bases of the industrial processes, general principles of construction, and equipment design. 49 tables, 93 figures, 111 references. (SJR)

33809 ELECTROLYTIC DEPOSITION OF PROTECTIVE TANTALUM COATINGS. Balikhin, V. S. (Inst. of Metallurgy, Sverlovsk, USSR). Prot. Metals (USSR) (Engl. Transl.); 10: No. 4, 425-426(1974).

Translated from Zashchita Metallov; 10: No. 4, 459-460(1974).

Electrodeposition of Ta from eutectic chloride and fluoride salt melts containing K_2TaF_7 was studied. Results are discussed showing that compact Ta coatings can be deposited by electrolysis of fluoride melts incorporating a soluble Ta anode. (JRD)

33810 DIRECT REDUCTION OF IRON ORES FOR FURTHER TREATMENT IN THE ELECTRIC ARC FURNACE BY MEANS OF NUCLEAR ENERGY. Wenzel, W. (Freiberg (German Democratic Republic)). Neue Huette; 19: No. 3, 129-132(1974). (In German).

A few possibilities of the iron and steel production by means of nuclear energy are briefly discussed. The development of gas cooled high temperature reactors renders it possible to use the nuclear heat escaped from the nuclear reactor. This process heat is applied to the direct reduction of iron ores for further treatment in arc furnaces. The international trends are outlined. In view of the unsolved technical and economical problems it is not to estimate if this technique provides a real cost reduction for each ton of steel. (INIS)

33811 ACTIVATED SINTERING OF TUNGSTEN. Avramova, B.; Khristov, G.; Mirchev, M.; Dyulgerov, G. Metalurgiya (Sofia); 28: No. 2, 23-25(Feb 1973). (In Bulgarian).

The activated sintering of W powder with the incorporation of a Ni-P alloy was studied. The greatest density and hardness of the sintered mouldings were obtained on using 0.25 wt. % of the Ni-P alloy and a sintering temp. of 1300°C. The results compared very favourably with those based on the addition of Ni powder by itself or a Ni-Si alloy. The microstructure was also more uniform, and the combination of mechanical properties (strength, ductility, and toughness) was superior. On the basis of these results, a W-base powder mixture giving high mechanical properties after low-temp. sintering and leaving only a small amount of superfluous phase is proposed. (Metals Abstr.)

33812 CONDITIONS FOR THE ROUTINE PREPARATION OF Ta-Al FILMS. Duckworth, R. G. (Ultra Electronics Ltd., London). Thin Solid Films; 26: No. 1, 77-98(Mar 1975).

Ta-Al alloy films of certain compositions have desirable properties for use in the fabrication of reliable micro-miniature resistors and capacitors. Process arrangements were studied for the more stable of these films, and accelerated life tests and structural analyses were made. The preferred film composition was found to result when the aluminium part of the target area was approximately 21% of the total, under sputtering conditions such that roughly equal numbers of tantalum and aluminium atoms were being removed from the whole of the bombarded surface. A maximum numerical value of −195 ppm/°C for the temperature coefficient of resistance (t.c.r.) is achieved under these conditions and the specific resistivity is higher than for films containing either slightly more or slightly less aluminium. Also the t.c.r. is practically independent of film thickness at this composition, whereas deviations in aluminium content, in either direction, result in films with less negative t.c.r. values as the thickness of deposit is increased. The type of sputtering used was not changed over the period of the work, but significant improvements in deposition rate and reproducibility were achieved by paying close attention to the provision of a stable environment in which to perform the process, and by careful substrate preparation and handling. The availability of higher purity sputtering targets led to further improvements in film quality. Although the work was directed towards the production of a specific alloy film, the method is applicable to the controlled deposition of alternative binary alloy films of pure metals. (auth)

33813 BORON COATING INTERACTION WITH CARBON ON MOLYBDENUM AND TUNGSTEN. Evtushok, T. M.; Zhunkovskij, G. L. (AN Ukrainskoj SSR, Kiev. Inst. Problem Materialovedeniya). Zashch. Pokrytiya Metal.; 192-195(1973). (In Russian).

A study was made of the possibility of using diffusion boride layers on molybdenum and tungsten as barriers against carbonization of the latter metals, and temperature limits were established for the stability of boride layers in contact with various, carbon-containing media. It is shown that the phase composition of boride layers changes during annealing; lower boride phases appear which are unstable with respect to carbon. The formation and rate of growth of these lower boride phases determine respectively the beginning and rate of interaction of the boride barrier layer with the carbon-containing medium. It is shown that the stability of the boride barrier layers depends on the physical state of the contacting substances and the medium in which the interaction takes place. (tr-auth)

33814 DIFFUSION PROCESSES OBSERVED IN WELDING OF ALUMINIUM-BERYLLIUM ALLOYS. Komarov, M. A. Avtomat. Svarka; No. 4, 19-22(Apr 1974). (In Russian).

For English translation see the journal Autom. Weld.

An analytical study was carried out of the redistribution of beryllium in welds of aluminum-beryllium alloys. It is shown that for sections containing a higher content of beryllium the calculated data on the distribution of beryllium agree satisfactorily with experimental data. (tr-auth)

33815 FEATURES OF WELDING OF NIOBIUM ALLOY HARDENED BY ZIRCONIUM NITRIDE. Zabolotin, S. P.; Nerodenko, M. M. (AN Ukrainsktoj SSR, Kiev. Inst. Ehlektrosvarki); Moiseev, V. F.; Pechkovskij, Eh. P.; Trefilov, V. I. (AN Ukrainskoj SSR, Kiev. Inst. Metallofiziki). Avtomat. Svarka; No. 4, 5-18 (Apr 1974). (In Russian).

For English translation see the journal Autom. Weld.

The absorption of nitrogen by seam metal on an alloy with 3 vol % zirconium nitride (0.35 wt % N) was determined as a function of the partial pressure of nitrogen in the welding chamber and the rate of welding. The effect of thermal treatment on the mechanical properties of the seam metal is determined. (tr-auth)

33816 WELDING IN NUCLEAR ENGINEERING. Lectures of the 2nd International Colloquy, Duesseldorf, Germany, October 23-24, 1974. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). 335p. (In German and English). (CONF-741092-).

Welding methods and the mechanical properties of welded joints and the heat affected zone are discussed for steels and alloys used in reactor components. Emphasis is placed on component cracking and reactor maintenance. Abstracts were prepared for forty-eight of the papers. (PMA)

For abstracts of individual papers see: 33817-33850, 33946-33950, 35145, 35209, and 35602-35608.

33817 INFLUENCE OF TEMPERATURE AND TENSILE STRESS CYCLES, CAUSED BY WELDING ON THE FORMATION OF CRACKS IN THE HEAT-AFFECTED ZONE OF A PRESSURE VESSEL STEEL. Theis, K.; Eichhorn, F. pp 9-17 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

After a description of the intercrystalline cracks found in the weld cladding of 22 NiMoCr 37 steel in the coarse-grain zone of the heat-affected zone, the temperature and stress cycles occurring in these crack-susceptible zones during welding are discussed. The results reported in the literature on the origin of these cracks are briefly compiled. The use of the photoemission electron microscope is discussed with respect to the analysis of the type of crack and the point of time for the origin of the crack. The results discussed, together with observations obtained by other surface analyzers, lead to a model of crack origin which result from processes at the grain boundary. Precautions to be taken to avoid underclad cracks are discussed. (tr-auth)

33818 INFLUENCE OF DIFFERENT ELEMENTS ON THE SUSCEPTIBILITY FOR UNDERCLAD CRACKING AS DETERMINED WITH WELD SIMULATION TESTS. Mulder, J. P. F. pp 19-22 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

Six basic steels, including ASTM A-508, ASTM A-533, and some with compositions deviating from nuclear reactor quality were remelted with small additions of elements under investigation. Samples were given a thermal cycling simulating a weld heat affected zone, and were then subjected to low rate tensile tests at 600°C. The resulting total plastic elongation just before fracture was used to characterize the susceptibility for underclad cracking at stress relieving temperatures. Results: (1) Mo, V, Nb gave a negative effect (plasticity decrease); (2) Si shows a positive effect; (3) W, Mn show tendencies for positive effects; (4) Cu, Cr tend towards negative effects; and (5) Ni influence is not clear. (PMA)

33819 PREVENTION OF UNDERCLAD CRACKING BY HIGH FREQUENCY INDUCTION HEATING. Yamazaki, Y.; Amano, M.; Naiki, T.; Saiga, Y. pp 25-33 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The optimum conditions for the elimination of underclad cracking by high frequency induction heating (HFIH) was established for overlay weldments using ASTM-A508 and ASTM-A533 steels as base metals and 308 stainless steel as the overlay. HFIH improved the mechanical and structural properties, particularly the notch toughness. The corrosion resistance and ferrite content of the clad metal was not markedly decreased, even after eight HFIH applications. (PMA)

33820 NORMALIZING OF STRIP CLAD HEAT-AFFECTED ZONES BY TIG-REMELTING. Mulder, J. P. F. pp 35-37 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

TIG (tungsten-inert gas) electric arc remelting was shown to prevent underclad cracking, when performed with carefully chosen welding parameters. Additional beneficial effects were: (1) a smooth clad surface; (2) a fine division of δ-ferrite; and (3) removal of slag inclusions and porosity. (PMA)

33821 PRACTICAL EXPERIENCE AND FUNDAMENTAL EXAMINATION TO AVOID STRESS RELIEF CRACKING IN THE HEAT-AFFECTED ZONE OF NUCLEAR CONSTRUCTION STEELS. Dittrich, S.; Grosse-Woerdemann, J.; Hauck, G. pp 47-54 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

A brief review is first given of the known factors in crack formation in the heat-affected zone of reactor construction steel. Experimental results on the effect of welding and annealing conditions on the formation of stress relaxation cracks are reported. Studies on the relaxation of the welding quality showed the effect of the low-stress annealing on the cold-working limits and cold-drawing stability of the steel. The stability properties of welds at high temperatures were also determined. Relaxation studies on different weld compounds were made to determine the best compositions. A weld compound with 1.5% Mn, 1.0% Ni, and 0.6% Mo gave the best results. The temperature dependence of the yield point and tensile strength and the impact strength and stability of this welding compound were also experimentally determined. (JSR)

33822 MORPHOLOGY OF THE TEXTURES AND THE MECHANICAL-TECHNOLOGICAL PROPERTIES OF THE BASE MATERIAL AND THE HEAT-AFFECTED ZONE. Mueck, G. H.; Grossmaas, H. pp 55-62 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering: Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

Pieces of 22 NiMoCr 37 steel were used to study the reaction of the steel to heat processing and welding and the contribution of individual factors to its behavior under these conditions. The effect of hardening, tempering, and low-stress annealing on the thermal processing behavior was studied. The weldability of the steel under various welding conditions was determined. The texture and its effect on mechanical properties such as impact strength were evaluated. (JSR)

33823 MEASUREMENTS PERFORMED ON THE TEMPERATURE DISTRIBUTION IN THE HEAT-AFFECTED ZONE OF SEAM WELDS AND CLADDINGS. Klausnitzer, E.; Belicic, M. pp 63-69 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The temperature-time curves in the heat-affected zones of seam welds and claddings were experimentally determined for the different welding procedures used in the construction of reactor components. The experimental results showed the effect of the welding powder on the cooling curve. The instrumentation of the thick-walled forging of 22 NiMoCr 37 was described in detail. (JSR)

33824 METALLURGICAL FEATURE AND CORROSION RESISTANCE OF AUSTENITIC WELD OVERLAYS BY THE SUBMERGED-ARC STRIP PROCESS. Thier, H.; Adam, W. pp 77-83 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

Experimental studies showed that the metallurgical reactions between welding flux and strip electrodes can be clearly and quantitatively characterized by an alloy vector. The dependence of the alloy vector on the welding voltage and current intensity was shown. Mixing with the base material is exclusively dependent on the welding rate. With the use of the alloy vector and the mixing, the chemical composition of the cladding can be calculated in advance from the strip electrode and the base material. The calculations agree with the determined chemical composition within the limits of error. The study of the susceptibility of the austenitic strip cladding to intercrystalline corrosion led to the formulation of intercrystalline corrosion diagrams. The effect of C, Nb, and Cr on the site and magnitude of the intercrystalline corrosion field was discussed. (tr-auth)

33825 EFFICIENCY INCREASE IN SUBMERGED-ARC WELDING WITH STRIP ELECTRODE. Huwer, W.; Eichhorn, F. pp 91-97 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering: Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The experimental installation developed to test the efficiency of submerged-arc welding using wide strip electrodes with widths up to 210 mm was described. Experimental results obtained on 22 NiMoCr 37 steel were reported. In spite of increased welding difficulties, satisfactory claddings could be obtained. The effect of the welding current intensity and welding rate on the geometric characteristics of the welding was examined. In welding with magnetic arc control using time-altering supplementary magnetic field, the pendulum behavior of the arc can be evened out. The perturbing effect of the magnetic blast effect could be avoided by the use of constant supplementary magnetic fields. The experimental results indicate that the efficiency limit of wide strip electrodes has not been reached. (JSR)

33826 CERAMIC-TO-METAL SEALING PROCESSES FOR HIGH OPERATING TEMPERATURES. Doerre, E.; Capelletti, C. M. pp 99-106 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

For the preparation of high-temperature stable Al_2O_3-base ceramic–metal seals, various methods are used which are char-

acterized by a solid and high-vacuum tight union between the ceramic and the metal partner. The binding mechanism is achieved either through a reaction layer as in active soldering and metallizing methods or by purely adsorptive linkage as in diffusion and sintering methods. The properties of the products prepared by these methods were compared with each other. Their advantages and disadvantages were discussed and the limits of their applicability were evaluated. Examples of the practical application of these methods were briefly reported. (tr-auth)

33827 METALLURGICAL PROCESSES IN BRAZED JOINTS WITH EXAMPLES OF HIGH-TEMPERATURE STAINLESS STEEL BRAZED JOINTS. Lison, R.; Gerken, W. pp 107-114 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The metallurgical processes occurring in brazing joints in both the liquid phase and the solid phase are briefly outlined. The changes in the mechanical properties as a result of diffusion in the heat-affected zone are summarized. The diffusion pattern and the temperature, concentration, and hardness distributions were experimentally determined for a series of brazing compounds in stainless steel brazed joints. These curves are given. (JSR)

33828 MICROSTRUCTURE OF BRAZED JOINTS MADE OF HEAT RESISTING MATERIALS WITH FILLER METALS ON Ni–Cr-BASIS AND THEIR INFLUENCE ON DUCTILITY OF THE JOINTS. De Paoli, A.; Colbus, J. pp 115-121 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The microstructure was studied as a function of the joint gap and the diffusion annealing in brazed joints of an austenite and a Cr steel with three Ni-based brazes and one gold braze. The impact strength of both notch and unnotched joints in the austenite steel was strongly affected by the microstructure. Especially in joints with BNi-5, an increase of the mechanical properties was found with reduction of the gap and with extension of the annealing time. The combination of austenite and BNi-2 also gave relatively good impact values. With BNi-7 the brazed joints had a low plasticity because of the erosion and the low phosphorus solubility in the steel. The same brazes in joints with Cr steel had lower impact strengths. Metallographic studies and hardness tests gave no indication on the increased formation of brittle phases in the Cr steel with respect to the austenite. (tr-auth)

33829 CRACKING SUSCEPTIBILITY OF HIGH TEMPERATURE BRAZED JOINTS. Draugelates, U.; Steffens, H. D.; Wielage, B. pp 123-127 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The fracture mechanics of NiCr20TiAl (Nimonic 80 A) brazed at high temperature with NiCrSi-NB30 were studied to determine the conditions under which brittle fracture occurs. The effect of brazing faults, inhomogeneities, and fatigue cracks was examined. The experimental results showed that the fracture ductility values found give a good foundation for the evaluation of the ductility behavior of brittle-fracture prone joints. (JSR)

33830 APPLICATION OF EB-WELDING FOR MANUFACTURE OF STEAM BOILER ELEMENTS IN A LOW ALLOY, MANGANESE CONTAINING STEEL (WALL THICKNESS 123 mm). Masnou, C.; Foulquier, H.; Saglio, R. pp 127-134 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

Special problems are encountered in the welding of thick plates. The studies made to determine the most suitable welding parameters for the welding of steam boiler elements under vacuum by electron beams were described in detail. The electron beam device and the ultrasonic instrument for testing for faults were discussed. On the basis of the experimental results obtained, two welds were made on a 3-m long steam boiler with wall thickness of 123 mm and 1670 mm diameter. Ultrasonic testing of the welds showed no failures in the welds or the heat-affected areas and the mechanical properties of the welds were satisfactory. (JSR)

33831 ELECTRON-BEAM WELDING OF SOME SPECIAL COMPONENTS FOR IRRADIATION-EXPERIMENTS AND FOR UF_6-TECHNOLOGY USING RARE MATERIALS. Mayer, H. G.; Koeppe, A. pp 135-138 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

In irradiation experiments and in UF_6 technology, components made of unusual materials and with complicated geometries are often needed. The use of electron beam welding in the fabrication of these components was evaluated. Electron beam welding techniques were developed from the viewpoint of applicability to the fabrication of such components. As examples, components of Mo, V, Cr–Ni steel, Ni, Ag, and Ag compounds were successfully welded using the electron beam welding techniques developed. (JSR)

33832 RECENT DEVELOPMENTS OF WELDING WITH HIGH INTENSITY BEAMS. Sepold, G.; Steffens, H. D. pp 139-142 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

Electron beam welding has been used for the solution of special welding problems in reactor construction. The improvements made in this technique have centered on the development of movable units, improvements of air welding procedures, and development of high power installations for deep penetration welding. These methods were supplemented by the introduction of continuously operating high power lasers with which deep penetration welds can also be made. Examples are given of the practical use of both techniques. (JSR)

33833 DEVELOPMENT OF DISSIMILAR MATERIAL WELDING METHOD OF THE PRESSURE TUBE-EXTENSION TUBES FOR THE PROTOTYPE ADVANCED THERMAL REACTOR FUGEN. Morisawa, J.; Shibatoh, E.; Koyama, T.; Minato, A.; Watanabe, K. pp 143-154 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The weldability and mechanical properties of heat affected zones were studied for some Ni–Cr steels used in BWR type reactors. The tensile strength, bending characteristics, and notch toughness of the welded joints, in addition to the hardness of the base metal, met design specifications. No microstructural abnormalities were observed. (PMA)

33834 ELECTROSLAG WELDING WITH A CONSUMABLE GUIDE PLATE AND FIBERIZED FLUX. Stark, L. E. pp 155-159 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

A new vertical electroslag welding process for joining thick sections was developed. The new process offers an opportunity for a new welding product, fiberized welding flux, and would use an industrial fiberized refractory material to help make a seal between the weld and the copper side plates. For thicknesses over 100 mm, the new process is many times faster than submerged arc welding or conventional electroslag welding. Welds were made in mild steel, ASTM A302B, and ASTM A533B plates, and showed good impact and tensile properties after heat treatment. (PMA)

33835 CONTRIBUTION ON THE DIFFUSION WELDING OF INCONEL 600. Verheyden, L.; Felix, F.; Noltes, G. pp 159-165 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The results of experimental studies on the diffusion welding of Inconel-600 were reported. The method and installation used for the welding studies was first described. The Vicker's hardness, length, electrical resistance, and tensile strength of the welded samples were tested before and after welding, and the results are tabulated for the 15 tests made. Curves reflecting the various processes occurring during the welding operation are given. (JSR)

33836 D-GUN COATINGS FOR NUCLEAR INDUSTRY. Schwarz, E. pp 165-169 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The principles of detonation plating or coating and the methods used in its application are described. The thermal stresses on the material during detonation coating, the characteristics of the most used detonation coatings, the coating thickness and quality, machinability of detonation coatings, and the shapes and sizes that can be coated by this technique are discussed. Examples are given of the application of detonation coating of structural elements of different types of reactors. (JSR)

33837 PLASMA HOT WIRE CLADDING IN NUCLEAR MANUFACTURE. Bernstein, A.; Areskoug, M.; Kirmborn, G.; Ruckdeschel, W.; Knoch, R. pp 171-176 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

Experimental evaluations were made of the plasma hot wire cladding technique for austenitic Cr–Ni stainless steels and a Ni–Cr–Nb alloy. The welding parameters were outlined and the surface condition of the material to be welded was described. The microstructure of the welded zone was determined with a consideration of the ferrite content and the phases in the transition zone. The phases detected in the heat-affected zone were described. The structure of the weld site could be analyzed by ultrasonic testing. (JSR)

33838 INFLUENCE OF SULPHIDES ON HOT CRACKING AND NOTCH TOUGHNESS IN HEAT-AFFECTED ZONE DURING WELDING OF HIGH-YIELD STEELS. Wellnitz, G.; Schmidtmann, E. pp 177-183 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

Studies have shown that sulfides at the temperatures occurring in heat-affected zones melt and move to primary grain boundaries forming sites for hot cracks. This surface-type distribution leads to a decrease of the notch impact strength. It was shown that the hot ductility test is a useful criterion for evaluation of the susceptibility of the steels to hot cracking. The effect of the Mn/S ratio and the various sulfide compositions and their melting points were first determined. The effect of Cr, Ni, Ce, and Ti on the sulfide composition and their effects on hot cracking were evaluated. (JSR)

33839 HIGH-TEMPERATURE UNSTABILIZED AUSTENITIC STEEL X 6 CrNi 1811 FOR SODIUM-COOLED REACTOR VESSELS, SUBMERGED ARC WELDING. Wallner, F.; Herberg, G. pp 195-201 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The use of submerged arc welding of thermally stable unstabilized austenitic steel for the construction of reactor vessels was evaluated. The requirements placed on the base material and the welding material were outlined, and the technique of submerged arc welding was briefly described. Experimental results on hot cracking, mechanical properties of weld joints, supplementary use of weld powder, and embrittlement were reported and discussed in detail. The distribution of delta ferrites in the weld metal proved a limiting factor. The results showed, however, that this technique yields welds with good mechanical properties and no hot cracking. It is applicable to the fabrication of pressure vessels for sodium-cooled reactors. (JSR)

33840 NEW UNDERSTANDING OF THE MIG-WELDING OF AUSTENITIC STEELS. Thier, H.; Plaschka, K. pp 203-213 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

Experimental studies showed that the welding behavior of austenitic wire electrodes depends on the feedability and arc behavior of the electrode and the flow behavior of the weld bath. By careful control of the general mechanical properties and the amount and composition of the non-metallic inclusions it is possible to produce wire electrodes which meet the highest specifications. The metallurgical characteristics of the protective gasses made it possible by use of a burnup vector to calculate the composition of the pure weld deposit. With knowledge of the base material and the mixing at the weld, the chemical composition of each weld bead can be determined. The maintenance of given limits to the chemical composition and to the ferrite content of the weld is as controllable as in other welding procedures. The stability of the weld against intercrystalline corrosion was determined. (tr-auth)

33841 QUALITY FEATURE OF AUSTENITIC COVERED WELDING ELECTRODES FROM METALLURGICAL POINT OF VIEW. Linssen, G. pp 221-231 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The criteria used in the selection of an austenitic rod electrodes for welding procedures in reactor construction are illustrated by an examination of the welding of austenitic claddings for pressurized water and boiling water reactor vessels and components. The welding techniques and mechanical characteristics of the welds of interlays and overlays are described. The metallurgical properties of the austenitic claddings are considered with respect to hot cracking, ferrite content, stability against intercrystalline corrosion, and ductility. The welding of the X6CrNi1811 steel for the SNR-300 is described. The specifications placed on the error limits in chemical analyses of welds, fuel rod composition, chemical composition of metallic cladding constituents, and cladding characteristics are summarized. (JSR)

33842 MECHANICAL-TECHNOLOGICAL PROPERTIES OF THE BASE MATERIAL AND WELDED ASSEMBLY (EMPIRICAL EXAMINATIONS OF THE STEEL 22NiMoCr37). Grossmann, H.; Mueck, G. H. pp 239-243 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

For the construction of reactor pressure vessels in Germany the annealed steel 22NiMoCr 37 has been used. The welding of this steel was done primarily by the submerged arc welding process. The mechanical tests made on this steel and its weld joints are described and the results are reported in detail. The results obtained on the expansion strength, elongation fracture, and shrinkage under various heat treatments and the notch impact tests of both the steel alone and its weld joints are reported graphically. The need for a quality assurance program is considered because the condition of the base material and the welding conditions can alter the mechanical properties of the steel and its weld joints. (JSR)

33843 MECHANICAL PROPERTIES OF BUTT WELDS OF HEAVY WALL REACTOR COMPONENTS. Cerjak, H.; Papouschek, F.; Pellkofer, D. pp 245-254 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The mechanical properties of butt welds of 22NiMoCr 37 using welding material of the low-alloy MnMo and NiCrMo type were examined on 140 representative weld samples, and the results were reported and discussed. Statistical data are given on tensile tests at room temperature and 350°C, impact tests, composition of weld deposit, and the structure of the heat-affected zone. The results showed that the MnMo-typing welding material gave butt welds with a slightly lower strength than the other welding compound. The notch impact tests showed that the weld and the heat-affected zone had greater strength than the base material. (JSR)

33844 CRACKS IN THE HEAT-AFFECTED ZONE DURING WELDING OF AUSTENITIC TUBES OF SMALL WALL-THICKNESS. Mussmann, P. E. pp 273-274 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

A leak was detected in the area of the welding seam in a thin-walled Cr–Ni steel piping through the concrete containment vessel. Microscopic and electron microscopic examination of the failure showed that the crack followed the intercrystalline boundaries. These studies showed that in crack vicinity and at the grain boundaries there was a Zn-rich phase. Possible causes for the formation of this Zn-rich phase were discussed. (JSR)

33845 EXAMINATION OF WELDMENTS OF A SODIUM LOOP OF STAINLESS STEEL NO. 4571 AFTER OPERATION. Borgstedt, H. U.; Frees, G.; Drechsler, G. pp 309-314 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

A sodium loop constructed of stainless steel X 10 CrNiMoTi 18 10 was welded by the TIG method with filler. An exhaustive examination was made of the loop welds after 28,000 hrs of operation with Na under dynamic conditions at 380 to 600°C. No Na corrosion effects were detected. (JSR)

33846 DEVELOPMENT OF EQUIPMENT AND METHODS FOR TYPICAL JOINING PROBLEMS IN NUCLEAR TECHNOLOGY. Lehrheuer, W.; Lison, R.; Springer, W. pp 315-319 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

On the basis of several examples, the specific problems found in the joining of special nuclear components and the solutions

adopted to overcome these problems are discussed. The connection of a thermal conductor to an irradiation capsule, welding of capsules filled with inert gas or liquid metal, automatic welding of piping for loop sections, high temperature brazing of individual small components, and diffusion welding of steel–Al tube overlays are described. (JSR)

33847 MECHANICAL PROPERTIES OF NARROW-GAP WELDS IN STEEL 22NiMoCr37. Henderson, I. D.; Seifert, K.; Steffens, H. D. pp 321-330 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The first results obtained in the narrow-gap welding of the reactor construction steel 22NiMoCr37 with section thicknesses up to 100 mm are reported. The strength and ductility properties of the weld are determined and compared with that of the base material. A primary problem was the selection of the composition of the filler wire. Metallographic examinations showed that a fine-grained weld texture and a heat-affected zone of only about 1 mm wide could be obtained with the welding technique used. (JSR)

33848 HARDFACING OF HEAT-RESISTANT ALLOYS ON SEALING SURFACES OF HIGH PARAMETER STEAM VALVES. Frumin, I.; Gladkii, P.; Zheremeev, V.; Pereplotschikov, E. pp 331-339 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

Experimental comparison of Ni–Cr–Si–B and Co–Cr–W alloys for hardfacing of heat-resistant alloys showed that the Ni–Cr–Si–B is superior in crack stability under rapid temperature changes, in erosion stability, and in other mechanical properties. Bench tests showed their usefulness in high-parameter steam. Plasma powder welding was more advantageous than welding with a melting electrode. The dependence of the burning penetration on the welding current intensity, the powder feed rate, and the welding rate was determined. An installation was developed for plasma welding and tested on the welding of Ni–Cr–Si–B alloy in steam temperature up to 565°C and pressures up to 12,000 N/cm^2. (JSR)

33849 EXPERIENCES WITH AUTOMATIC WELDING OF THIN-WALLED ALUMINUM TUBES. Iversen, K.; Schellong, B. pp 341-347 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The principles, techniques, and quality control of welding thin-wall Al tubing are discussed. Specific examples are reported to illustrate the difficulties and solutions adopted. (JSR)

33850 SOME CONSIDERATIONS ON INTERNAL WELDING OF SMALL-SIZE TUBES FOR NUCLEAR PLANT. Aota, T.; Shimizu, S.; Inagaki, M.; Okada, A. pp 349-355 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

A new technique was developed for internal TIG welding of small-sized, thick-walled tubing used in steam generators, superheaters, and reheaters for FBR type reactors. It was found that the use of a previously mixed argon-helium shield gas with a shield gas pressure difference control (between the outside and inside of the tube) gave satisfactory welds. (PMA)

33851 RADIAL DISTRIBUTION OF IMPURITIES AND STRUCTURAL DEFECTS IN SINGLE CRYSTALS OF NIOBIUM GROWN BY CRUCIBLE-FREE ELECTRON BEAM ZONE FUSION. Esin, V. O.; Belova, N. V.; Dubrovskii, A. Ya.; Kozlov, F. N. (Inst. of Metal Physics, Moscow). Fiz. Metal. Metalloved.; 38: No. 5, 1101-1105(Nov 1974). (In Russian).

The effect of the conditions of crystal growth on the radial distribution of impurities and structural defects was studied in Nb single crystals by measurement of the relative residual electroresistivity. The experimentals results showed that in order to reduce the radial inhomogeneities of the distribution of impurities and structural defects of refractory crystals obtained by crucible-free electron beam zone fusion the growth must take place under conditions guaranteeing a very flat form of the crystallization front. (JSR)

33852 ROLE OF ORDERING IN THE PROCESSES OF Fe–Ni–Co–Mo ALLOY MARTENSITE AGING. Kablukovskaya, M. A.; Mogutnov, B. M. (Inst. of Metal Science and Physics of Metals, Moscow). Dokl. Akad. Nauk SSSR; 220: No. 1, 71-73(1 Jan 1975). (In Russian).

The specific heats of carbon free steel and martensites of Fe–Ni–Co–Mo alloys were measured under different thermal processing conditions in order to determine the role of ordering in the aging process. The results indicated that those singularities of aging such as the formation of an intermediate ω phase and recovery are the result of ordering. (JSR)

33853 PURIFYING ZIRCONIUM BY ZONE RECRYSTALLIZATION IN VACUUM. Azhazha, V. M.; V'yugov, P. N.; Reshetova, L. N.; San'kov, A. A.; Tarasova, M. I. Izv. Akad. Nauk SSSR, Metal.; No. 1, 41-44(1975). (In Russian).

In a vacuum obtained by cryogenic methods the purification of zirconium from oxygen is more effective than in a vacuum obtained by evacuation with oil pumps having nitrogen protection. After six passes of zone melting the results of chemical analyses for oxygen, nitrogen, and carbon in various sections of the zone-melted rod showed a concentration gradient along the length of the rod. Significant purification from oxygen was noted. The purification from nitrogen and carbon was smaller. (SJR)

33854 DEOXIDATION OF MOLYBDENUM DURING ELECTRON-BEAM MELTING. Chernov, V. S.; Busol, F. I.; Koretenkova, A. D.; Nam, B. P. Izv. Akad. Nauk SSSR, Metal.; No. 1, 31-35(1975). (In Russian).

It was found that the final content of oxygen in molybdenum melted by electron-beam in vacuum does not depend on the type and amount of deoxidizing addition and also on the amount and form of oxygen in the charge mixture. The final oxygen content is stabilized at a level of about 10^{-3} wt.%. This stabilization sets in after a definite time of holding molybdenum in the liquid state (about 1 to 2 min). The favorable effect of a number of additives on the plasticity of cast molybdenum is explained by the accumulation of the additives at the phase boundaries and by the local deoxidation (refining) of grain boundaries. (SJR)

Properties, Structure, and Phase Studies

Refer also to abstracts 32638, 32978, 33741, 33748, 34074, 34473, 35309, 35310, 35387, 35522, and 35609.

33855 (AD-777416) INVESTIGATION OF THE TECHNOLOGICAL PLASTICITY OF Ti–Al AND Ti–Al–V ALLOYS. Atroshchenko, A. P.; Bogoyavlenskii, K. N.; Ushkov, S. S. Translated from Obrab. Metal. Davleniem Mashinostr.; No. 6, 46-53(1971). 10p. NTIS $4.00.

Results are presented of an investigation of the technological plasticity of titanium alloys—aluminum and titanium–aluminum–vanadium consisted in the tensile testing of smooth specimens and the upset testing of cylindrical specimens under different temperatures. (GRA)

33856 (AD-783352) EVALUATION OF SHEAR-SPUN Ti–3Al–2.5V TITANIUM ALLOY HYDRAULIC TUBING. Final Report, July 1973–April 1974. Sanders, L. R. (McDonnell Aircraft Co., St. Louis, Mo. (USA)). May 1974. Contract F33615-72-C-1923. 23p. NTIS $3.00.

The objective of the program was to evaluate hydrostatically extruded Ti–3Al–2.5V hydraulic tubing. However, shear-spun tubing had to be substituted for evaluation. Tests conducted on the shear-spun tubing included rotary flexure and impulse fatigue, flaring, bending, flattening, and tensile strength. The shear-spun tubing was found to be inferior to conventionally produced tubing because of poor surface finish. (GRA)

33857 (AD/A-000345) STRAIN RATE DEPENDENCE OF THREE HIGH STRENGTH NAVAL ALLOYS. Technical Report, 1 February 1971–31 March 1974. Conn, A. F.; Rudy, S. L.; Howard, S. C. (Hydronautics, Inc., Laurel, Md. (USA)). Jun 1974. Contract N00014-71-C-0220. 122p. NTIS $5.25.

The properties of three alloys were studied: a type HY-80 steel, a type HY-130 steel, and a titanium alloy: Ti-6211. (6Al 1Nb 0.8Mo 1Ta). These materials were subjected to a wide range of uniaxial tensile rates of straining at room temperature. Included are results of static tests, rapid loading tests, and dynamic tests. The results are replotted to demonstrate the dependence of stress as a function of rate of straining. It is concluded that these materials demonstrate a monotonic increase in stress as a function of strain rate. (GRA)

33858 (AD/A-000690) SURFACE PROPERTIES, SURFACE REACTIONS, AND EPITAXIAL GROWTH. Final Progress Report, 1 December 1972–31 May 1974. Jona, F. (State Univ. of New York, Stony Brook (USA)). Jun 1974. 10p. (AFOSR-TR-74-1715). NTIS $3.25.

Studies of epitaxial systems were continued with the deposition of silicon on the beryllium (0001) surface and of silicon on the

molybdenum (001) surface. The atomic arrangements on clean silver (0001) and clean molybdenum (001) surfaces were determined. The methods for determination of the vibration amplitudes of surface atoms were successfully tested by a computer experiment and then applied to the clean (001) surface of silicon. The structure of one monolayer of selenium on silver (001) and that of a monolayer of silicon on molybdenum (001) was determined. The structures of overlayers of oxygen, nitrogen and carbon monoxide on the molybdenum (001) surface are presently being studied. (GRA)

33859 (AD/A-000955) OBSERVATIONS OF THE USE OF THE MODIFIED WOL SPECIMEN FOR ENVIRONMENTAL TESTING OF TITANIUM ALLOYS. Cox, T. B.; Gudas, J. P. (Naval Ship Research and Development Center, Annapolis, Md. (USA)). Nov 1974. 20p. (MAT-74-43). NTIS $3.25.

The modified wedge-opening-loading specimen is attractive for use in subcritical cracking tests in various environments. However, results of the current study indicate that care should be exercised in using this specimen with titanium alloys. It was observed that subcritical crack growth occurs in air within short times after loading modified wedge-opening-loading specimens of Ti–6Al–4V and Ti–6Al–2Nb–1Ta–0.8 Mo. There is as yet an incomplete understanding of what effects this subcritical cracking may have on the subsequent behavior of the specimen in the test environment. Until there is a better understanding of the subcritical cracking problem of titanium in air, it is recommended that load application be made in the environment or that specimens be placed in the environment immediately upon loading. (GRA)

33860 (AECL-4669) STRUCTURES OF AS-MELTED AND HEAT TREATED Zr_3Al-BASED ALLOYS. Cameron, D. J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Nov 1974. 39p. Dep. NTIS (US Sales Only) $4.00. AECL $1.00.

The structures observed in cast samples of alloys containing from 4 to 12.4% Al are presented and described. The structure of alloys containing less than 9.5% Al are discussed in terms of two previously suggested solidification mechanisms based on solidification of β–Zr solid solution grains followed by precipitation of Zr_4Al_3 and Zr_2Al, and on the concept of nonequilibrium, coupled zone eutectic solidification. It is concluded that the evidence clearly supports the precipitation mechanism. An alternative view of the precipitation process is presented. The structures of transformed alloys are strongly influenced by the distribution of phases in the cast structures, and by the alloys as a pseudo-ternary system, Zr–Al– impurities, so that at equilibrium three phases, α–Zr, Zr_3Al, and Zr_2Al, are usually present in alloys containing more than 8% Al, when they are prepared from commercial-purity materials. It is suggested that minimization of interfacial energies may also play a role in the phase distribution after long, transformation heat treatments. (22 figures) (auth)

33861 (AECL-5020) EFFECT OF COOLING RATE ON THE STRUCTURE OF A SOLUTION-TREATED ZIRCONIUM–8.6 WT.% ALUMINUM ALLOY. Schulson, E. M.; McColl, D. H. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Dec 1974. 18p. Dep. NTIS (US Sales Only) $4.00. AECL $0.50.

The effect of the rate of cooling through the $\beta(Zr) + Zr_2Al$ two-phase field on the structure of a solution-treated Zr–8.6 wt % Al alloy of commercial purity has been examined. The results show that the scale of the Zr/Zr_2Al duplex structure (i.e., the size of the Zr_2Al precipitates) is proportional to the cube root of the time of passage through the $\beta + Zr_2Al$ region. This behavior is interpreted in terms of standard nucleation, growth and particle coarsening processes. (auth)

33862 (AGN–8214) EVALUATION STUDY OF HASTELLOY X AS A NUCLEAR CLADDING. Quarterly Progress Report, 1 October–31 December 1966. (Aerojet-General Corp., San Ramon, Calif. (USA). Nuclear Products and Services Group). Feb 1967. 49p. Dep. NTIS $5.50.

Microconstituent analysis of both low and commercial cobalt tubing verified the presence of sigma phase in this alloy in specimens exposed at 1300 and 1450°F. This contradicts statements in the literature which establish major quantities of gamma prime $Ni_3(Al,Ti)$ or eta phases as a condition necessary to formation of sigma in nickel-base alloys. The major phase that can be identified in samples exposed at temperatures in excess of 1450°F is M_6C, with lattice parameters varying between 10.927 at 1600°F and 10.977 at 1800°F. $M_{23}C_6$ carbides may also be present. Oxidation penetration data for the low and commerical cobalt tubing exposed between 1300 and 1800°F were analyzed to determine the time and temperature dependence of this reaction. These analyses indicate that the limiting oxygen transport mechanism changes from diffusion through the oxide film to diffusion through the metal matrix at temperatures low in this range. Regression analyses of the penetration data were performed to determine activation energies for the oxidation reaction. Electron microprobe analyses show that the oxide film formed on Hastelloy X is composed of two layers; the outer layer has an approximate composition of $MnCr_2O_4$; the inner layer is rich in chromium alone. Electron microscopic examination of specimens has permitted detailed analysis of the structure present in the Hastelloy X alloy. Preliminary examination of a specimen aged for 10,000 h at 1450°F has not yet resulted in identification of sigma phase. Room temperature tensile testing of specimens exposed up to 7500 h at 1900 and 2000°F was completed. All samples tested reached a ductility maximum after 100 h, followed (in samples from two heats) by a sharp decrease in ductility after 1000 h. The ductility increased after this decrease until 2500 h, after which it decreased gradually with increasing exposure. Samples from one heat did not follow this pattern but showed a gradual ductility decrease commencing after 100 h. Comparison of bending creep data and tensile creep data for Hastelloy X materials in air at 1800°F revealed a systematic difference. The tensile creep rates increase and reach a maximum depending upon applied stress. Bending creep curves follow a more classical form, having a short primary creep stage followed by an extended secondary stage. The tensile creep curves can be modified to approximate those of bending creep by removal of the surface layer (consisting of the oxide layer and layer depleted in carbide precipitates) from the test specimens. The carbide depleted layer and the oxide layer reappear in a short time and cause an increase in the creep rate. Centrifugal creep testing of specimens of three heats of Hastelloy X for 1000 h in air and in argon was initiated. (DLC)

33863 (AGN-8241) EVALUATION OF HASTELLOY AS A NUCLEAR CLADDING. Monthly Progress Report for August 1967. (Aerojet-General Corp., San Ramon, Calif. (USA). Nuclear Products and Services Group). Sep 1967. 4p. Dep. NTIS $4.00.

Progress on the oxidation studies and the mechanical properties evaluation of Hastelloy X is reported; no data are given. (DLC)

33864 (AGN-8246) EVALUATION STUDY OF HASTELLOY X AS A NUCLEAR CLADDING. Quarterly Progress Report, 1 July–30 September 1967. (Aerojet-General Corp., San Ramon, Calif. (USA). Nuclear Products and Services Group). Nov 1967. Contract AT(04-3)-368. 59p. Dep. NTIS $6.00.

Results of oxidation testing of Hastelloy X containing differing amounts of Co are presented along with results of Hastelloy X mechanical tests at 1900°F in air and creep tests at 1300 and 1400°F. (JRD)

33865 (BNL-19551) MAGNETIC EXCITATIONS IN RARE EARTH Al_2 COMPOUNDS. Bak, P. (Brookhaven National Lab., Upton, N. Y. (USA)). Dec 1974. 22p. (CONF-741202-17). Dep. NTIS $4.25.

From 20th annual conference on magnetism and magnetic materials; San Francisco, California, USA (3 Dec 1974).

In the rare earth intermetallic compounds, the crystal field is often comparable to the exchange interaction between the magnetic ions. The magnetic excitations (excitons) in such systems are transitions between single-ion atomic levels, propagating through the lattice via the exchange interaction. Recent experimental and theoretical work on rare earth Al_2 compounds is reviewed. The excitons in $NdAl_2$ and $TbAl_2$ have been studied by inelastic neutron scattering. The dispersion relations are analyzed within the random phase approximation using a Hamiltonian including 4th and 6th order crystal field terms and an isotropic exchange interaction. The spectrum of $NdAl_2$ at 5°K comprises both transverse and longitudinal modes, corresponding to transitions between the ground state and excited mean-field states. The bulk magnetic properties of $NdAl_2$ can be understood quantitatively using the crystal field parameters derived from the analysis of the exciton spectrum. At 4°K the magnetic excitations in $TbAl_2$ are spin waves. At temperatures above 35°K the neutron scattering measurements show a double peak structure. This splitting of the spin wave branch is the result of an interaction between the spin-waves and excitations associated with higher-lying mean-field states, a magnon-exciton interaction. (auth)

33866 (BNWL-tr-138) PRECIPITATION OF CARBIDES AND FATIGUE RESISTANCE OF AUSTENITIC STAINLESS STEEL. Raoul, J. P. Translated by L. Appleby (Battelle Pacific Northwest Labs., Richland, WA), from Mem. Sci. Rev. Met.; 71: No. 4, 231-238(1974). 15p. Dep. NTIS $4.00.

This study considers the effect of mean applied stress and the precipitation of chromium carbides in the grain boundaries on the properties of fatigue resistance of austenitic stainless steel, expressed in terms of rupture mechanics. Results concern notably

the fatigue behavior of welded joints in stainless steels which would be insufficiently stabilized. (auth)

33867 (CEA-CONF-2875) SOLUTE EFFECTS ON SOLVENT ELECTROMIGRATION IN DILUTE ALLOYS. Doan, N. V.; Bocquet, J. L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Section de Recherches de Metallurgie Physique). 1973. 20p. (CONF-740827-4). Dep. NTIS (US Sales Only) $4.00.

From international conference on low temperature diffusion; Yorktown Heights, New York, USA (12 Aug 1974).

The effects of a small concentration of solute on the solvent electromigration are due to an enhancement effect of the solute atoms on the solvent diffusivity (which gives rise to the factor b') and a vacancy flow effect proportional to the flux of solute and to the term L_{AB}/L_{BB}. The theoretical expressions of b' and L_{AB}/L_{BB} are given for fcc and bcc alloys. This dependence on the solute concentration of the solvent electromigration can be combined with the solute diffusivity and the solvent-enhanced diffusion in order to determine the various vacancy jump frequency ratios in binary dilute alloys. The validity and the interest of this new method are illustrated by the first experiments performed on Ag-base Zn, Ag-base Cd, and Al-base Cu alloys. (auth)

33868 (COO-2305-2) ELECTRON-DISLOCATION INTERACTIONS AT LOW TEMPERATURES. Galligan, J. M. (Connecticut Univ., Storrs (USA). Dept. of Metallurgy). [nd]. Contract AT(11-1)-2305. 7p. Dep. NTIS $4.00.

Research results are reported on flow stress in superconducting crystals of Pb and Pb–Sn alloys, magnetization changes in Pb–In alloy crystals during dislocation occurrence, and preparation of high-purity Nb crystals. (JRD)

33869 (EURFNR-1195) DESCRIPTION OF THE CREEP CURVES OF TWO AUSTENITIC STEELS FROM CREEP RUPTURE TESTS WITH CONSTANT LOAD INCREASE RATE. Schaefer, L.; Closs, K. D. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung). Apr 1974. Translation of KFK-1963. 39p. Dep. NTIS $5.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Creep tests under linear increasing stress have been performed on unirradiated tubular specimens under uniaxial and biaxial stress conditions (steel No. 1.4981) and on unirradiated and irradiated sheet tensile specimens (steel No. 1.4970). Three methods have been evaluated for describing the creep curves under increasing stress. The three methods are: a graphic representation, an analysis of the creep rate as a function of stress and stress rate, and the application of the time-fraction rule for creep strength curves. The different methods give similar results. The advantages and disadvantages of the three methods are discussed. (auth)

33870 (FZK-181) INVESTIGATION OF THE EFFECTS OF RADIATION AND CRYOTEMPERATURE ON ENGINEERING MATERIALS. Test No. 2. Control Data. Bradford, E. W.; Thornton, H. G. (General Dynamics/Fort Worth, Tex. (USA)). 31 Mar 1964. 386p. Dep. NTIS $22.50.

For Aerojet-General Corp., Azusa, CA.

The irradiation test (no. 2 of the series) was terminated prematurely because of a fire in the GTR test cell, and will be rescheduled. The control tensile and shear data are presented for the materials: stainless steels 304, 321, 347, 440C; A-286; AM 350; Inconel X750; H Monel; Inconel 713C; TZM; A-110 AT; Armalon; Rulon; Teflon; Al alloys; Hastelloy C. (312 fig) (DLC)

33871 (GACP-4113) PROPOSAL FOR DEVELOPMENT OF SNAP FUEL ELEMENT CLADDING. (General Atomic Co., San Diego, Calif. (USA)). 25 Apr 1963. 37p. Dep. NTIS $5.00.

Declassified 28 Nov 1973.

Research directed to development of metallic cladding for Zr–U fuel rods for SNAP-type reactors is reported. Sections are included on cladding compatibility, fuel load calculations, and plans for future work. (JRD)

33872 (HEDL-TME-75-20) EFFECT OF STRESS RATIO UPON THE ELEVATED TEMPERATURE FATIGUE-CRACK GROWTH BEHAVIOR OF SEVERAL REACTOR STRUCTURAL MATERIALS. James, L. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Feb 1975. Contract AT(45-1)-2170. 45p. Dep. NTIS $5.45.

Linear-elastic fracture mechanics methods were used to characterize the effect of stress ratio upon several alloys used in reactor structural applications: Types 304 and 316 stainless steels, Inconel 600, Inconel 718, Incoloy 800, and A533-B steel. Tests were conducted at temperatures (depending upon the alloy) ranging between 75 and 1000°F, and at stress ratios ranging between R = −0.15 to R = 0.80. The effective stress intensity factor was used to correlate the results at the different stress ratios into a form that is more useful for structural analyses. (auth)

33873 (IS-T-656) HEAT CONTENT OF LIQUID CERIUM BY LEVITATION CALORIMETRY. Kuntz, L. K. (Ames Lab., Iowa (USA)). Feb 1975. Contract W-7405-eng-82. 82p. Dep. NTIS $7.25.

Thesis.

Levitation calorimetry was used to experimentally determine the heat content function of liquid cerium between 1400 and 2500°K. The heat content function between 1700 and 2500°K was found to be linear with respect to temperature. The heat content function in cal per mole is given as $H_T - H_{298.15} = [7.42 \pm 0.14]\ (T - 1077°K) + [9482.80 \pm 133.58]$ (1700°K < T < 2500°K). The heat capacity for this temperature range is 7.42 cal per mole per degree. The heat content function between 1400 and 1700°K was found to be nonlinear. The estimated heat content function for this temperature range in cal per mole is given as $H_T - H_{298.15} = -0.002905T^2 + 18T - 7976.3$ (1400°K < T < 1700°K). The estimated heat capacity in cal per mole per degree is given as $C_p = -0.00581T + 18$ (1400°K < T < 1700°K). (auth)

33874 (IS-T-658) EFFECT OF HYDROGEN ON THE CREEP PROPERTIES OF VANADIUM, NIOBIUM, and MOLYBDENUM. Mather, J. C. (Ames Lab., Iowa (USA)). Feb 1975. Contract W-7405-eng-82. 73p. Dep. NTIS $6.75.

Thesis.

Results of research on the effects of H on the creep properties of Nb, V, and Mo at 600 to 1000°C are presented. Sample preparation is described along with apparatus design and experimental procedure. Results are analyzed and presented in charts and figures. (JRD)

33875 (IS-T-661) SINGLE CRYSTALLINE ELASTIC CONSTANTS OF Al_2Cu AND Zr_2Ni. Eshelman, F. R. (Ames Lab., Iowa (USA)). Feb 1975. Contract W-7405-eng-82. 58p. Dep. NTIS $6.00.

Thesis.

A pulse-echo-overlap system was used to measure the single crystalline elastic constants of the tetragonal Zr_2Ni and Al_2Cu phases in the temperature range 4.2 to 300°K. The mathematical relationships needed to calculate these elastic constants have been determined. The longitudinal elastic constants of Zr_2Ni, C_{11} and C_{33}, both exhibit a monotonic decrease with increasing temperature. The C_{66} shear constant of Zr_2Ni has a 72% monotonic increase with increasing temperature in the 4.2 to 300°K range and the other shear constants, C_{44} and $\frac{1}{2}(C_{11}-C_{12})$, are essentially temperature independent. The shear constants are noticeably smaller than the longitudinal constants, with C_{66} only 3.5% of C_{11} at 4.2°K. All the elastic constants of Al_2Cu exhibit a monotonic decrease with increasing temperature. The C_{44} values of Al_2Cu show a 2% variation with direction that has been attributed to the presence of occluded particles of a second phase whose long dimension is oriented normal to the [001] direction. There is evidence that Al_2Cu forms peritectically which gives rise to the second phase particles. Arguments are given to show that the maximum error from the occluded second phase particles is about 2%. Zr_2Ni and Al_2Cu both have low longitudinal elastic anisotropy ratios and at least one high shear anisotropy ratio. In addition, one shear anisotropy ratio changes by 50% or more in the 4.2 to 300°K range. The polycrystalline moduli for Zr_2Ni and Al_2Cu from Voigt-Reuss-Hill averaging are given. The low shear modulus for Zr_2Ni is in keeping with the low values of the shear elastic constants of single crystals of this phase. The Debye temperatures for these phases are given. (auth)

33876 (IS-T-662) THERMODYNAMIC STUDY OF PHASE STABILITY IN THE THORIUM–COPPER EQUILIBRIUM SYSTEM. Bailey, D. M. (Ames Lab., Iowa (USA)). Feb 1975. Contract W-7405-eng-82. 45p. Dep. NTIS $5.25.

Thesis.

The thermodynamics of formation of the four intermediate phases in the thorium–copper equilibrium system were evaluated from electromotive force data obtained from solid state electrochemical cells with a calcium fluoride electrolyte. The free energies and enthalpies of formation are essentially constant, in units of kcal/g-atom Th, for the thorium-poor phases in this system, a feature shared with the Th–Fe, Th–Co, and Th–Ni systems. The trend in the magnitude of the enthalpy of formation of the thorium-poor phases in the Th–Fe, Th–Co, Th–Ni, and Th–Zn systems is in accord with the bonding energies for the $d^{n-2}sp$ valence states for the respective transition metals (and for zinc): the value for the Th–Cu system is lower, corresponding more closely to the bonding energy of the monovalent $d^{10}s$ state for copper. (auth)

33877 (N-74-20127) DEVELOPMENT AND FRACTURE MECHANICS DATA FOR 6Al–6V–2Sn TITANIUM ALLOY. Final

Report. Fiftal, C. F.; Beck, E. J. (Martin Marietta Corp., Denver, Colo. (USA). Aerospace Div.). Jan 1974. Contract NAS9-13599. 97p. (NASA-CR-134209; MCR-74-43). NTIS $8.00.

Fracture mechanics properties of 6Al–6V–2Sn titanium in the annealed, solution-treated, and aged condition are presented. Tensile, fracture toughness, cyclic flaw growth, and sustained-load threshold tests were conducted. Both surface flaw and compact tension-specimen geometries were employed. Temperatures and/or environments used were –65°F air, ambient, 300°F air, and room-temperature air containing 10 and 100% relative humidity. (STAR)

33878 (N-74-32354) EFFECTS OF PROOF LOADS AND COMBINED MODE LOADINGS ON FRACTURE AND FLAW GROWTH CHARACTERISTICS OF AEROSPACE ALLOYS. Shah, R. C. (Boeing Aerospace Co., Seattle, Wash. (USA). Research and Engineering Div.). Mar 1974. Contract NAS3-14346. 276p. (NASA-CR-134611; D-180-17997-1). NTIS $17.00.

An experimental program was undertaken to determine the effects of (1) combined tensile and bending loadings, (2) combined tensile and shear loadings, and (3) proof overloads on fracture and flaw growth characteristics of aerospace alloys. Tests were performed on four alloys: 2219-T87 aluminum, 5Al-2.5Sn (ELI) titanium, 6Al-4V beta STA titanium and high strength 4340 steel. Tests were conducted in room air, gaseous nitrogen at –200°F, liquid nitrogen, and liquid hydrogen. Flat center cracked and surface flawed specimens, cracked tube specimens, circumferentially notched round bar, and surface flawed cylindrical specimens were tested. The three-dimensional photoelastic technique of stress freezing and slicing was used to determine stress intensity factors for surface flawed cylindrical specimens subjected to tension or torsion. Results showed that proof load/temperature histories used in the tests have a small beneficial effect or no effect on subsequent fracture strength and flaw growth rates. (STAR)

33879 (NP-20367) EXPERIMENTAL INVESTIGATION OF SAFETY AGAINST UNSTABLE FRACTURE OF THE PRESSURE COMPONENTS OF NUCLEAR REACTOR. (Science and Technology Agency, Tokyo (Japan)). 1973. 260p. (In Japanese).

According to the criterion of safety assessment for brittle fracture of nuclear reactor containment in Japan, the minimum service temperature must not be lower than NDT + 17°C for stresses lower than yield point, and NDT + 67°C for over yield stress. On the other hand, with the recent development of structural analysis techniques, it has been contemplated that some extent of plastic region may have to be permitted in case of accident. Then, the service temperature is required to be 50°C higher than elastic use from the above rule. This requirement seems to be very stringent for conventional carbon steels. From this point of view, it was the main purpose of the investigation to study the rationality of the present rule. A large-scale brittle fracture arrest test was carried out for welded joints of the steel for nuclear reactor containment. Then, it was found that the present rule is too conservative in case of over yield stress. In addition to this, it was made clear that the present rule, which is based on the Fracture Analysis Diagram concept, is short of confirmed logic. Furthermore, some kinds of brittle fracture tests were carried out and compared each other to obtain basic data for attaining an appropriate assessment test method and a new reasonable criterion for brittle fracture. The test methods used were Charpy impact test, drop weight tests, three points bending test, deep notch test, compact tention test, ESSO test, dynamic tear test, and drop weight tear test. The welded joints were examined by means of these methods, and brittle fracture characteristics were investigated together with the results of the base metal which had been examined in the previous year. Through analysis of the results, some correlations between large scale and small scale tests were obtained. Using these correlations, though there are still some problems to be solved, it was found that there is some possibility of attaining a new reasonable criterion for safety assessment based on a small scale test. (auth)

33880 (NP-20368) EXPERIMENTAL AND THEORETICAL RESEARCH ON STRENGTH DESIGN CRITERIA CONSIDERING FATIGUE AND CREEP INTERACTION OF NUCLEAR REACTOR MATERIALS. (Science and Technology Agency, Tokyo (Japan)). 1973. 196p. (In Japanese).

This research program was started in 1973, on a three-year program, with the object of getting fundamental data for strength design rules of structural components of nuclear reactors. In fatigue-creep interaction tests uniaxial small specimens of SUS 316 and SUS 304 stainless steels, a 2–1/4Cr–1Mo steel and their welded joints are used to investigate the effects of strain rate and hold time on the number of cycles to failure at 350, 550 and 650°C, respectively. In thermal ratchetting tests the three-bar model of a SUS 316 stainless steel is used to examine the thermal ratchetting behavior, while the mechanical ratchetting behavior is experimentally investigated with the cylinderical specimens of SUS 316 stainless steel at room temperature, 350, and 550°C and analyzed theoretically using a finite element method. In the fiscal year 1973 low-cycle fatigue tests were carried out to investigate the effects of strain rate, hold time with relaxation (strain-controlled), and hold time with creep (load-controlled) on the number of cycles to failure of SUS 316 stainless steel specimens at 350, 550, and 650°C. The experimental results showed that number of cycles to failure increased with increasing strain rate, whereas failure life decreased with decreasing strain rate. In the test of hold time with relaxation it was ascertained that the number of cycles to failure decreased with increasing hold time. In these tests the number of cycles to failure was dependent on temperature and decreased with temperature increase. It was confirmed from the experimental results of hold time with creep and strain-controlled low-cycle fatigue tests that the number of cycles to failure decreased with increasing temperature and strain range, influenced remarkably by creep damage. In the thermal ratchetting test, using the three-bar model of SUS 316 stainless steel, the threshold level and growth behavior of ratchetting deformation were ascertained and it became clear that the deformation decreased gradually with the increasing number of cycles. The growth behavior of mechanical ratchetting deformation was observed from the experimental results of the cyclic axial loading test under constant internal pressure, but the threshold and decrease of the ratchetting deformation with cyclic loading could not be confirmed in these test. This growth behavior of the deformation was analyzed by finite element method. (auth)

33881 (PB-237086) ROOM TEMPERATURE TENSILE PROPERTIES OF TITANIUM AND SEVEN TITANIUM ALLOYS PREPARED BY SKULL CASTING. Calvert, E. D.; Lowery, R. R. (Bureau of Mines, Albany, Oreg. (USA). Albany Metallurgy Research Center). Sep 1974. 32p. (BM-RI-7949). NTIS $3.75.

The room temperature tensile properties of commercially pure titanium and seven titanium alloys prepared by skull casting were determined in the As-cast and heat-treated conditions. Data were compared with property data from tensile tests on wrought alloys of the same compositions in the As-worked and heat-treated conditions. The alloys evaluated were Ti–5Al–2.5Sn, Ti–6Al–4V, Ti–6Al–4V–1Si, Ti–6Al–2Sn–4Zr–2Mo, Ti–6Al–6V–4Zr–4Mo, Ti–6Al–6V–2Sn, and Ti–11.5Mo–6Zr–4.5Sn. Test specimens were prepared from both static and centrifugal castings and from plate fabricated forging and rolling vacuum-melted ingots. (GRA)

33882 (RD-68-128) PRELIMINARY INVESTIGATIONS INTO FORGEABILITY AND MECHANICAL PROPERTIES OF ELECTROSLAG REMELTED HASTELLOY X ALLOY. Jahagirdar, A. R. (Wyman-Gordon Co., North Grafton, Mass. (USA)). Sep 1968. 25p. Dep. NTIS $4.25.

A program was undertaken to evaluate the forgeability and mechanical tensile properties of the alloy made by electroslag remelting and compare with the results obtained on the same alloy made by vacuum arc remelting. It was found that the electroslag remelted Hastelloy X has good forgeability. The strength properties of electroslag remelted (ESR) Hastelloy X are similar to vacuum arc remelted (VAR) Hastelloy X but the ductility properties are significantly better. This alloy appears crack sensitive and care must be exercised to prevent overheating during cutting or other metal removal operations. Lowering the post-forge solution treatment temperature increases yield strength properties with some decrease in ductility. (auth)

33883 (RD/B/N-2980) EFFECT OF CARBON TRANSFER BETWEEN STAINLESS (AISI 316) AND FERRITIC (2¼Cr, 1Mo) STEELS IN SODIUM. Charnock, W.; Cordwell, J. E.; Gwyther, J. R.; Hobdell, M. R. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1974. 27p. (FRDC/CEWP/P-(74)16; FRDC/FEWP/CPN-302; FRDC/MWP/P-(74)16). Dep. NTIS (U. S. Sales Only) $4.50.

Carbon activity changes at 913K in sodium containing the alloys AISI 316 and 2¼Cr–1Mo steel were monitored using an electrochemical cell. In the first 100 hours of exposure, a large activity change from ~1 to 0.16 occurred. In a further 700 hours, the activity fell steadily but slowly to 0.11. Discontinuities on the activity/time curve suggest that the rate of carbon transfer between these steels is not controlled simply by a single diffusion process. The effect of sodium exposure upon the microstructure and upon some mechanical properties of the steels was examined. A steep gradient of grain boundary carburization was found to extend to the midsection of the 760μm thick AISI 316 specimens. There was uniform decarburization of the 2¼Cr–1Mo steel. Accurate weight gain measurements confirmed that appreciable carbon

transfer had occurred. Such effects would be expected to cause appreciable deterioration in the long term creep properties of these materials. However, the effects of these changes on short term tensile test properties and upon microhardness could not, in general, be detected. An exception was a single room temperature tensile test on an AISI 316 specimen in which a moderate reduction in ductility occurred in association with some intergranular cracking. (auth)

33884 (RDT-M-1-10T(3-75)) NICKEL AND NICKEL ALLOY COVERED WELDING ELECTRODES (ASME SFA-5.11 WITH ADDITIONAL REQUIREMENTS). (USERDA Division of Reactor Research and Development, Washington, D. C.). Mar 1975. 4p. RSO.

A standard prescribing requirements for Ni and Ni alloy covered welding electrodes (ASME SFA-5.11 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 1-10T, dated July 1971. (JRD)

33885 (RDT-M-2-15T(2.75)) NICKEL–CHROMIUM ALLOY BARS, FORGINGS, AND FORGING STOCK (ASME SA-637 AND ASTM A 637 WITH ADDITIONAL REQUIREMENTS). (USERDA Division of Reactor Research and Development, Washington, D. C.). Feb 1975. 7p. RSO.

A standard prescribing requirements for Ni–Cr alloy bars, forgings, and forging stock (ASME SA-637 and ASTM A637 with additional requirements for nuclear and associated applications is presented. This standard supersedes RDT M 2-15T dated April 1973. (JRD)

33886 (RDT-M–3-6T(3-75)) AUSTENITIC STAINLESS STEEL PIPE (ASME SA-312 WITH ADDITIONAL REQUIREMENTS). (Energy Research and Development Administration, Washington, D. C. (USA). Div. of Reactor Research and Development). Mar 1975. 9p. RSO.

A standard prescribing requirements for austenitic stainless steel pipe (ASME SA-312 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 3-6T, dated November 1973. (JRD)

33887 (TID/SNA-1222) CRYOGENIC TENSILE PROPERTIES OF SELECTED AEROSPACE MATERIALS. Weleff, W.; Emmons, W. F.; McQueen, H. S. (Aerojet-General Corp., Sacramento, Calif. (USA)). 18 Aug 1964. 47p. Dep. NTIS $5.50.

Tensile properties data are presented on fifteen materials which were tested at 75°F, –100°F, –320°F, and –423°F. The test equipment and methods are described. The test results are also discussed. Materials evaluated were: titanium alloys (5 Al–2.5 Sn ELI, 6 Al–4V ELI); stainless steels and iron-base alloys (321, 347C, AM350, A286, 18% Ni maraging steel); nickel-base alloys (Hastelloy C, Inconel X-750, Inconel 713-C); and aluminum alloys (A356-T6, 2219-T81, 5456-0, 6061-T6, 7079-T6). (21 fig, 9 tables) (auth)

33888 (TID/SNA-1325) TOPICAL REPORT MATERIALS AND PROCESSES DEVELOPMENT. Contract Year 1963 (October 1962–September 1963). (Aerojet-General Corp., Sacramento, Calif. (USA)). 18 Oct 1963. 29p. Dep. NTIS $4.50.

Results of research are reported on tensile properties of A-286 bolt material, tensile properties of Ti-base pressure vessel materials, fabrication of NERVA rocket chamber cast Al jackets, brazing alloys for NERVA nozzle fabrication, and brazing alloys for 347 stainless steel. (JRD)

33889 (TID/SNA–1506) SHEAR STRENGTH OF SEVERAL ALLOYS AT LIQUID HYDROGEN TEMPERATURES. Weleff, W.; Emmons, W. F.; McQueen, H. S. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1964. 18p. Dep. NTIS $4.00.

Eighteen alloys in four different groups of materials were tested in double shear: (1) Al alloys: A 356-T6, 2219-T81, 5456-0, 5456-H, 6061-T6, 7075-T6, 7079-T6. (2) Ti alloys: A-110-AT and A-110-AT-ELI. (3) Stainless steels and Fe-base alloys: 304, 321, 347, 410, 347-C, 17-7PH, AM350, and A286. (4) Ni-base alloys: Hastelloy C and Inconel X750. (DLC)

33890 (TRG-Report-1759(R/X)) THERMODYNAMIC PROPERTIES OF Na, Al_2O_3, Mo, AND UO_2 ABOVE 2000°K. Booth, D. L. (UKAEA Reactor Group, Risley). Nov 1974. 35p. Dep. NTIS (U. S. Sales Only) $4.75.

A bibliography of the properties of Al_2O_3, Mo and UO_2 was used to produce estimates of their densities, enthalpies and vapor pressures in the ranges 2,000–4,000°K. The critical constants of sodium are discussed. The preferred critical data are roughly 2,800°K, 440 bars and 0.18 g/cc. These numbers were obtained by fitting experimental data on saturated liquid sodium and its vapor below 1,700°K. A generalized equation of state correlation has been used to calculate the properties of sodium over a wide range of conditions. (auth)

33891 (UJV-3178-M) ORIENTATION OF BASAL PLANE IN SINTER MAGNESIUM-BASED COMPOSITES. Kuzelka, J. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Nov 1974. 23p. (In Czech). Dep. NTIS (U. S. Sales Only) $4.25.

The orientation of the basal plane in sintered and extruded magnesium based products (Mg–2%Be, Mg–0.5%MgF_2, Mg–0.1%MgO, Mg–3%MgO, Mg–5%MgO) was determined by x-ray diffraction of longitudinal sections. Experiments carried out on tubes and cylindrical and rectangular bars showed that the basal plane (containing the extrusion direction) was preferentially oriented perpendicular to the product surface. (auth)

33892 (WANL-TME-397) ADDITIVE OXIDATION TEST. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Jul 1963. 15p. Dep. NTIS $4.00.

Oxidation tests conducted to evaluate the effects of various additives on the oxidation rates of graphite and fueled graphite are reported. Values for reaction rates and weight percent burnup for refractory materials and metal samples are tabulated. (JRD)

33893 (WANL-TMI-1403) DEVELOPMENT PROGRAM FOR CARBON PRODUCTS DIVISION HIGH CTE GRAPHITE FLOUR. Kirkhart, F. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Feb 1965. 10p. Dep. NTIS $4.00.

Activities in a program to evaluate graphite powders as fuel matrix materials are reported. Results of basic property studies are presented along with results of preliminary processing investigations, results of NERVA fuel processing investigations, and fuel element extrusions. (JRD)

33894 (WANL-TMI-1470) PRELIMINARY TEST RESULTS ON BERYLLIUM HIGH STRAIN FATIGUE TEST (EML-82). Kallin, I. N. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 18 May 1965. 6p. Dep. NTIS $4.00.

Results of tension–compression cycling of large Be specimens are presented. The tests were conducted to determine the shock resistance of reflector components. Results are analyzed and presented in charts and figures. (JRD)

33895 (WANL-TMI-1667) BERYLLIUM THERMAL SHOCK TEST. Igne, E. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Apr 1966. 6p. Dep. NTIS $4.00.

A test was performed to determine the stress required to reinitiate cracking in a beryllium specimen that had been cracked initially by means of a thermal shock. Inspection of the specimen after thermal shocking revealed that the thermal shock produced three transverse cracks in the specimen webs. These cracks were about 1-1/8 inches apart and were in a plane normal to the axes of the specimen and direction of gas flow. A longitudinal crack also occurred at one end of the specimen webs. This crack is in direction of the gas flow. (auth)

33896 (WANL-TMI-1692) STATIC TENSION TEST ON INCONEL 718 TIE RODS: PART NO. 945C568-H01-K. Hengstenberg, T. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 18 Jul 1966. 1p. Dep. NTIS $4.00.

Results of tensile tests on three Inconel 718 tie rods are tabulated. (JRD)

33897 (WANL-TMI-1693) STATIC TENSION TESTS ON HOLLOW TIE RODS: PART NO. 979D144-H03-E. Hengstenberg, T. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 18 Jul 1966. 1p. Dep. NTIS $4.00.

Results of tensile tests on two Inconel 718 hollow tie rods are tabulated. (JRD)

33898 (WANL-TMI-1703) Q. C. TENSILE TEST ON INCONEL 718 TIE RODS. Part No. 945C568-H01-K. Hengstenberg, T. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 9 Sep 1966. 1p. Dep. NTIS $4.00.

Results of tensile tests on six Inconel 718 tie rod samples are tabulated. (JRD)

33899 (WANL-TMI-1876) SUMMARY REPORT ON LOW CYCLE FATIGUE TESTS ON BERYLLIUM REFLECTOR MATERIAL EML-A2-01. Igne, E. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 27 Feb 1968. 7p. Dep. NTIS $4.00.

Results of strain cycling tests on Be are presented. A complete strain history on a Be specimen at 530°R is given tabularly along with tables showing strain/cycle data at 140°R. Plots of the strain amplitude vs cycles to failure are also included. (JRD)

33900 (WANL-TMI-1934) BERYLLIUM PROPERTIES TESTS. Morgan, L. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Sep 1968. 3p. Dep. NTIS $4.00.

Double cantilever beam (DCB) specimens were tested at 140°R temperature to establish the fracture toughness of beryllium by determining the loads and deflections at which initial and subsequent crack propagation occurs. Four specimens were made from S-200 block pressed material and four were made from A-6 ring pressed material, pressing number 4055. Results indicate that there is no significant difference in fracture toughness properties of S-200 block pressed and ring pressed material. (JRD)

33901 (WANL-TR-6559) TRIP REPORT TO WARREN, OHIO (MEETING: COORDINATION GROUP FOR MILITARY HANDBOOK 5). Layland, E. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 Nov 1970. 12p. Dep. NTIS $4.00.

This handbook is used as a source of materials properties data. The meeting was centered on fatigue and fracture properties of alloys used in aircraft. (DLC)

33902 (WANL-TR-6694) TRIP REPORT TO ALCOA EXTRUSION PLANT, LAFAYETTE, INDIANA. McAndrew, J. B. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 21 Jan 1972. 2p. Dep. NTIS $4.00.

The purpose was to observe the extrusion of 8 BATH powder compacts to 2.5-in. bar per P. O. 59-FZL-22836-M (NERVA). Results were similar to previous extrusion runs on Al alloy extrusions. Blistering and "pine-cone" structure were produced by variations in extrusion speed. Recommendations are given for future runs. (DLC)

33903 (WARD-HT-3045-8) VALIDATION OF HIGH TEMPERATURE DESIGN METHODS AND CRITERIA. Quarterly Progress Report for Period Ending November 30, 1974. Bishop, E. C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Mar 1975. Contract AT(11-1)-3045. 116p. AT.

The objectives are to determine the inelastic (elastic + plastic + creep) behavior and strain tolerances of Type 304 and 316 stainless steels, and to validate analysis methods and design criteria for LMFBR components. Progress includes specimen testing, structure testing, FFTF/IHX inlet nozzle testing, base specimen grid strain data, high-temperature design standards, and crack propagation testing. Creep data are given for Types 304 and 316 stainless steel. (DLC)

33904 (Y-1862) METHOD FOR DETERMINING THE COEFFICIENT OF LINEAR THERMAL EXPANSION OF REACTOR FUEL ELEMENTS. Smith, J. H. (SEE CODE- 9500170 Union Carbide Corp., Oak Ridge, Tenn. (USA). Y-12 Plant). 18 Dec 1972. Contract W-7405-eng-26. 24p. Dep. NTIS $4.25.

Declassified 21 Mar 1975.

A test method has been developed for determining the coefficient of linear thermal expansion in the longitudinal and transverse directions (to extrusion) for reactor fuel elements. The test method is straightforward and can be applicable to coefficient of linear thermal expansion tests on many other materials. (auth)

33905 EFFECT OF ELECTROLYTIC POLISHING AND CADMIUM PLATING ON PENETRATION RATE OF HYDROGEN THROUGH 65G STEEL. Zhitenev, V. I.; Strizhak, V. A.; Seredkina, L. P.; Levchenko, V. P.; Ryabov, R. A. (Ural Polytechnic Inst., Sverdlovsk, USSR). Prot. Metals (USSR) (Engl. Transl.); 10: No. 4, 429-430(1974).

Translated from Zashchita Metallov; 10: No. 4, 462-463(1974).

The hydrogen permeability of 65 G steel membranes in the 150 to 310°C range was studied. It was found that electrolytic polishing of the membrane lowers the rate of hydrogen penetration. Cadmium plating on hydrogen entrance side of the membrane was found to greatly reduce penetration rates. The penetration rate is also temperature dependent. (JRD)

33906 PROPERTIES OF FILMS OF SUPERCONDUCTING Nb_3Ga ALLOYS PRODUCED BY EVAPORATION IN VACUO. Golovashkin, A. I.; Levchenko, I. S.; Motulevich, G. P. (Lebedev Inst. of Physics, Moscow). Sov. Phys.-Solid State (Engl. Transl.); 16: No. 7, 1368-1369(Jan 1975).

Translated from Fiz. Tverd. Tela; 17: No. 7, 2100-2102(Jul 1974).

The temperature at transition to the superconducting state in this alloy is 20.3 to 20.1°K. The critical temperature is 19.65 to 19.3°K. Only A-15 phase was found in the Nb_3Ga specimens. (JRD)

33907 INTERACTION OF ABRIKOSOV EDDIES WITH A CRYSTAL LATTICE IN A TYPE II SUPERCONDUCTOR. Chigvinadze, D. G. (Inst. of Physics, Tbilisi, USSR). Sov. Phys.-Solid State (Engl. Transl.); 16: No. 7, 1292(Jan 1975).

Translated from Fiz. Tverd. Tela; 16: No. 7, 1986-1987(Jul 1974).

As they move, Abrikosov eddies entrain the crystal lattice, so that a resonance is excited in a niobium plate (pinned at one end) by a weak alternating field perpendicular to a strong constant field. The resonant frequencies increase as the constant field is strengthened. (auth)

33908 INFLUENCE OF TECHNOLOGICAL CONDITIONS ON THE STRUCTURE AND SUPERCONDUCTIVE PROPERTIES OF BANDS WITH A COATING OF Nb_3Sn. Savitskii, E. M.; Enman, V. K.; Mikhaylov, B. P.; Barov, V. V.; Krainskii, I. S.; Tregubov, V. N. pp 85-88 of Splavy Redkikh Metallov S Osobymi Fizicheskimi Svoystvami. Moscow; Izdatel'stvo Nauka (1974). (In Russian).

An examination is made of the influence which technological conditions (temperature of the tin bath, time of reaction of the niobium band with the tin, composition of the medium, and various methods of heat treatment) have on the phase composition, thickness, density, uniformity, and superconductive properties of bands with a coating of Nb_3Sn. The optimum temperature range for the tin bath (940 to 960°C) is established. It is shown that additional thermodiffusion annealing appreciably increases the thickness of the Nb_3Sn layer and raises the critical current. On the basis of microstructural studies a change is noted in the nature of formation of the Nb_3Sn layer during the continuous process due to the instability of the tin bath composition. Use of a color etching method gives a simple and reliable means of correcting the technological process to obtain bands with high superconductive parameters. (Referativnyi Zh.)

33909 SUPERCONDUCTIVITY OF SOME FOUR-COMPONENT PHASES WITH CRYSTALLINE STRUCTURE OF TYPE Cr_3Si. Ageev, N. V.; Shamrai, V. F.; Postnikov, A. M. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 216: No. 2, 309-310 (11 Mar 1974). (In Russian).

The superconductivity of the multicomponent phases with type Cr_3Si crystalline structure was studied. The critical temperatures and the lattice parameter a of the four-component phases with variable composition were measured for the pseudobinary systems Nb_3Al-V_3Si, Nb_3Al-V_3Ga, Nb_3Sn-V_3Si, Nb_3Sn-V_3Ga, and Nb_3Ga-V_3Si. (JSR)

33910 POLONII I EGO PRIMENENIYE. (Polonium and Its Applications). Ershova, Z. V.; Volgin, A. G. Moscow; Atomizdat (1974). 232p.

The basic physical-chemical properties of Po, the nuclear physics properties of its isotopes, and the interaction of its radiation with matter (ionization and thermal and radiation effects) are described. The different laboratory and industrial methods for the production of ^{210}Po, the apparatus design for technological processes, and questions of radiation safety during work with Po are examined. The use of Po preparations in scientific studies, medicine, and power engineering is examined. (tr-auth)

33911 PASSIVATION OF LOW-ALLOYED TITANIUM ALLOYS. Tomashov, N. D.; Ruskol, Yu. S.; Ayuyan, G. A.; Khrustaleva, G. N. (Inst. of Physical Chemistry, Moscow). Prot. Metals (USSR) (Engl. Transl.); 10: No. 4, 339-343(1974).

Translated from Zashchita Metallov; 10: No. 4, 363-368(1974).

Results of a study on the effects of alloying components such as Al, V, Mo, Zr, Nb, Cr, Mn, or Sn on the passivity of titanium alloys are presented. It is established that nearly all the additives studied (with the exception of Al and Zr) have no effect on the rate of the chemical dissolution of passive alloys, but change in different ways the rate of their anodic dissolution in the passive state. (auth)

33912 MAGNETIC RESONANCE AND RELATED STUDIES IN Ce-Sn ALLOY. Malik, S. K. (Tata Inst. of Fundamental Research, Bombay); Vijayaraghavan, R.; Garg, S. K.; Ripmeester, R. J. Phys. Status Solidi (b); 68: No. 1, 399-404(1 Mar 1975).

The results of nuclear magnetic resonance (NMR) and magnetic susceptibility measurements in $CeSn_3$ are presented together with other available data. The magnetic susceptibility of $CeSn_3$ shows a broad maximum around 135 K and a rapid rise below 30 K. The ^{119}Sn Knight shift in $CeSn_3$ in the temperature region 1.2 to 300 K is not proportional to the bulk susceptibility. The electrical resistivity of $CeSn_3$ shows a T^2 term at low temperatures as expected in localized spin fluctuation systems, and the coefficient of the electronic specific heat is also very large. These results suggest sizeable 4f occupation near the Fermi level in $CeSn_3$. (auth)

33913 THERMO EMF OF THE ALLOY Ni-8 AT. % Mo IN A WIDE TEMPERATURE INTERVAL. Kalinovich, D. F.; Koven-

skii, I. I.; Smolin, M. D.; Statsenko, V. M. (Inst. of Problems in Materials Science, Kiev). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 148-150(1974). (In Russian).

The thermo emf of the alloy was measured in the temperature interval from 100 to 1050°C and the specific electrical resistance was determined in the interval from 20 to 1050°C. The results are shown graphically. The temperature parameters of the electron and hole conductivities and the value of the Fermi energy were evaluated and tabulated. The two-zone model approximation agrees with experimental values. (JSR)

33914 NIOBIUM–GALLIUM PHASE DIAGRAM. Alayan, A. A.; Zamatorin, M. I. Sb. Nauch. Tr., Erevan. Politekh. Inst.; 35: No. 1, 186-191(1971). (In Russian).

Microstructural, X-ray, and thermal analyses were used to study the Nb–Ga system. The system has six intermetallic compounds, one of which, Nb_3Ga_2, melts with an open maximum at 1880°C. The compounds Nb_3Ga, Nb_3Ga_4, Nb_1Ga_3, Nb_3Ga_{13}, and $NbGa_3$ are formed by peritectic reactions at 1730, 1420, 1350, 1280, and 1205°C, respectively. The Nb_3Ga + Nb_3Ga_2 eutectic crystallizes at 1680°C and contains 24.5% Ga. The compounds Nb_3Ga and $NbGa_4$ have a homogeneous region 5-7% wide at room temperature. The solubility of Ga in Nb is ~5% and 14% at room temperature and 1730°C, respectively. (Ref. Zh.)

33915 EFFECT OF HEAT TREATMENT ON THE MAGNETIC PROPERTIES OF SINTERED ALLOYS OF THE PERMALLOY TYPE. Manukyan, N. V.; Sarkisyan, L. E. Sb. Nauch. Tr., Erevan. Politekh. Inst.; 35: No. 1, 208-213(1971). (In Russian).

Studies were made of the effect of porosity, temperature, and duration of annealing on the magnetic properties of alloys of Fe with Ni 50, 65, and 78.5% and a Mo Permalloy (Ni 78.5, and Mo 4.0%) prepared by reduction of the complex oxides $Ni_xFe_yMo_zO_u$. The x-ray analysis showed that reduction at 650-750°C yielded powders consisting of γ solid solutions of Fe in Ni with fcc lattices. Specimens with porosities of 0–15% were annealed at 1250°C for 3, 6, and 9 h and cooled by various regimes. The Mo Permalloy was also tempered for 2 h at 475-478 after air quenching from 650°C. The high Ni specimens, when cooled in a magnetic field, had a greater μ_{max}, (particularly with the Ni 65%) than in the annealed state. This method can provide sintered Permalloys with magnetic properties comparable to those of the cast materials. (Ref. Zh.)

33916 PROPERTIES OF NIOBIUM–GALLIUM ALLOYS. Zamatorin, M. I.; Alayan, A. A. Sb. Nauch. Tr., Erevan. Politekh. Inst.; 35: No. 1, 197-202(1971). (In Russian).

The hardness, ductility, and resistivity of Nb–Ga alloys with 9–21% Ga were determined with respect to annealing temperature. The hardness of alloys annealed at 1540°C increased with Ga content up to 18% but then decreased somewhat for 20–21% alloys, similar results being obtained with quench temperature of 1450 and 1600°C. The 9.6% alloy, when quenched at 1600°C, showed a sharp drop in hardness and an increased ductility (superplasticity) close to the $\alpha-(\alpha+\beta)$ boundary. Quenching from 1540 and 1600°C caused the appearance of extremely fine spheroidal particles of excess β phase (Nb_3Ga) with the presence of rather large coagulated particles in the grains and at the grain boundaries. 14–15% alloys quenched from 1730°C also showed superplasticity. The resistivity values obtained at 200, 400, and 600°C established that the bonding in all the intermetallic compounds of this system is mainly metallic. Other physico-mechanical properties, e.g., density, are also discussed. (Ref. Zh)

33917 TEXTURE OF METALS. Hu, H. (U. S. Steel Corp., Monroeville, PA). Texture; 1: No. 4, 233-258(Jun 1974).

A condensed review of casting, deformation, and annealing textures of polycrystalline metals and alloys is presented. It is intended to provide an informative but simplified reference for researchers, engineers, and students who are seeking quick information on the development of textures in various metal objects, and for those who are primarily interested in the textures of non-metallic materials, but wish to acquire a general background knowledge on the texture formation in metals. (auth)

33918 LIMITATIONS OF THE LATTICE MATCHING THEORY IN PREDICTING GaAs/BeO EPITAXY. Kenty, J. L. (Rockwell International Corp., Anaheim, CA). Thin Solid Films; 26: No. 1, 181-195(Mar 1975).

The atomic arrangements of the GaAs (100) and (111) planes have been compared for fit to the BeO (000$\bar{1}$), (10$\bar{1}$0), (20$\bar{2}$1), (10$\bar{1}$1), (10$\bar{1}$2), (1$\bar{2}$10), (1$\bar{2}$11), (1$\bar{2}$12) and (1$\bar{2}$14) planes. Lattice matching was calculated on both a 1:1 basis and a multiple atom basis for two perpendicular directions in the plane of the film. A figure of merit, formally similar to the elastic strain energy, was defined and used to rank the BeO planes in order of fit to the GaAs planes. Comparison with experimental data subsequently available demonstrated that lattice matching was of relatively little value in predicting the epitaxial relationships observed in the GaAs/BeO system. It was indeed misleading, for some predicted (low mismatch) orientations are not observed whereas some observed orientations have a large mismatch. (auth)

33919 WORK-HARDENING BEHAVIORS OF POLYCRYSTALLINE ALPHA ZIRCONIUM. Ramani, S. V.; Mukhopadhyay, P.; Rodriauez, P.; Krishnan, R. (Bhabha Atomic Research Centre, Bombay (India). Metallurgy Div.). Indian J. Technol.; 11: No. 11, 523-529(Nov 1973).

From international symposium on defect interactions in solids; Bangalore, India (9 May 1972).

The work-hardening behavior of polycrystalline alpha zirconium was investigated in the temperature range 77–442°K. More than one stage of work-hardening was observed at all temperatures of test and as such, the assumption that the flow curve could be characterized by a single parabolic equation of the type $\sigma = \sigma_0 + h\epsilon_p^m$ is not valid for zirconium. Further, work-hardening in zirconium is found to decrease with increase in temperature. Electron microscopic observations revealed a linear dependence of dislocation density with true plastic strain. While the first stage of hardening was observed to be due to dislocation multiplication in coplanar arrays, the second stage is associated with cross-slip taking place as revealed by cell formation at higher temperatures and strains. (auth)

33920 DISLOCATION-SOLUTE INTERACTIONS AND MECHANICAL BEHAVIOR OF ZIRCONIUM AND TITANIUM. Ramachandran, V.; Santhanam, A. T.; Reed-Hill, R. E. (Florida Univ., Gainesville (USA). Dept. of Metallurgical and Materials Engineering). Indian J. Technol.; 11: No. 10, 485-492(Oct 1973).

From international symposium on defect interactions in solids; Bangalore, India (9 May 1972).

Tensile tests were conducted on commercial purity zirconium and titanium between 77°K and the beta transus, at strain rates ranging over five orders of magnitude. The shapes of the stress-strain curves varied widely with temperature and strain rate largely due to dynamic strain aging. Both the metals exhibit a "blue brittle" effect like that observed in steels. The tensile elongation goes through a minimum at a certain temperature depending on the strain rate, with a sharply defined neck in the tensile specimen. At the same temperature, the reduction in area is very large, indicating a basically ductile failure. Another important aspect of dynamic strain aging is that it can produce very large work hardening rates. This effect is more pronounced in titanium than in zirconium. The work hardening rate may show a maxima in the dynamic strain aging region, that are strain rate dependent, moving to higher temperatures with increases in strain rate. This rate dependent work hardening is directly responsible for the fact that above the "blue brittle" temperature, the tensile elongation rapidly rises to a very high value, with the development of a diffuse neck in the tensile specimen. At still higher temperatures, the work hardening drops to low values. But the elongation continues to be large, over 100%. This can be attributed to the high strain rate sensitivity of the flow stress of the metals prevailing at these temperatures above the dynamic strain aging region. The importance of dynamic strain aging is further demonstrated by the fact that when the impurity level is reduced by an order of magnitude, most of the attributes of dynamic strain aging are either drastically reduced or eliminated. These are discussed with reference to titanium. (auth)

33921 THERMAL INSULATION MATERIALS FOR ULTRA-LOW TEMPERATURE. Ogino, O. (Mitsubishi Electric Corp., Amagasaki, Hyogo (Japan). Central Research Lab.). Denki Gakkai Zasshi; 94: No. 5, 383-385(May 1974). (In Japanese).

Essential points of the thermal insulation method at ultralow temperature and main factors affecting the thermal characteristics of insulation materials are reviewed. There is no thermal insulation material that can satisfy all necessary conditions of heat insulation. Therefore, several kinds of insulation materials are used in combination. In high vacuum insulation, high vacuum as low as 10^{-5} torr must be maintained by shielding radiation from high temperature walls with cooling shields. It requires strict fabrication. Evacuation-and-powder insulation can improve insulation characteristics at medium vacuum of about 10^{-3} torr. When liquid nitrogen shield is used for a liquid helium container, intruding radiation heat quantity can be reduced to less than 5%. A few problems of perlite affecting thermal characteristics are mentioned. Thermal conductivity varies markedly from 350 μW/cm°K at atmospheric pressure to 10 μW/cm°K at 10^{-3} torr. It is difficult to evacuate to vacuum once the perlite absorbs moisture. The thermal conductivity of perlite tends to decrease as its particle size reduces. Multiple layer insulation, called super-insulation, requires 10^{-5} torr for good insulation characteristics. It is difficult to make the external force exerted on the multiple layer as small as possible, and laminate them evenly. It requires a special jig and skill. (JA)

33922 NEUTRON DIFFRACTION OF Ti Ni. Crystalline Structure of Transition State. Takei, H. (Tohoku Univ., Sendai (Japan). Faculty of Engineering); Matsumoto, M.; Ogawa, T.; Shugo, Y.; Honma, T. Kakuriken Kenkyu Hokoku; 6: No. 2, 257-262(Dec 1973). (In Japanese).

Neutron diffraction study of Ti Ni was made at the temperature of maximum electric resistivity for the purpose to know crystalline structure at this state. Samples for the study were made from a Ti-52 at.% Ni plate of 1.5-mm thickness, and were treated at 1000°C for 2 h and furnace-cooled to homogenize. The neutron diffraction experiment was performed after the samples were water quenched and kept for one hour at room temperature, liquid nitrogen temperature and 500°C. The temperature at which measurement was carried out was room temperature, -68, -94, and -191°C. The time of flight (TOF) Debye-Scherrer method with the scattering angle of $2\theta = 90°$ was used. Obtained diffraction patterns are shown in figures. The patterns, which are seen in case of the Ti Ni samples treated at the temperature below 1000°C, show CsCl type. This result shows that the variation of resistivity-temperature curve cannot be explained by the regularity of arrangement of atoms. The separation of (100) line was seen in the pattern taken at -68°C. The peaks probably due to martensite phase were observed in the pattern at -94 and -191°C. The separation of the (100) and (110) peaks in this experiment was explained by the tetragonal system (a = 2.95Å, C = 3.04Å) with c/a = 1.03. However, some ambiguity remained. (JA)

33923 COOPERATIVE STUDY FOR STANDARDIZATION OF TESTING PROCEDURES FOR ZIRCALOY CLADDING TUBES FOR BWR, USING DOMESTICALLY MANUFACTURED ONES. Mishima, Y. (Tokyo Univ. (Japan). Dept. of Nuclear Engineering). Nippon Genshiryoku Gakkaishi; 16: No. 6, 306-311(Jun 1974). (In Japanese).

Quality evaluation of domestically manufactured zircaloy tubing for nuclear fuel cladding was carried out in 1972, with the view to utilizing the material in part of the reloading fuel assemblies for the Tsuruga Power Station of the Japan Atomic Power Co., on which occasion, some discrepancies were found among the test results obtained by several investigators who had contributed to the project. Consequently, a cooperative study was carried out for the purpose of standardizing the testing procedures. As a first step, the properties for examination were limited to tensile and burst tests, and to measurements of grain size and hydride orientation. The tests were repeated several times and the results obtained were compared. As a result, the test data obtained by the different investigators could be brought into satisfactory agreement and adopted as reliable practical criteria. (auth)

33924 AN EPITHERMAL NEUTRON DIFFRACTION OF Gd ALLOYS. Ishikawa, Y.; Tajima, K.; Kohgi, M.; Suzuki, M. (Tohoku Univ., Sendai (Japan). Dept. of Physics); Watanabe, N. Kakuriken Kenkyu Hokoku; 6: No. 2, 276-280(Dec 1973). (In Japanese).

An epithermal neutron diffractometer using an incident neutron energies ranging from 0.5 eV to 4 eV has been designed and has been installed at the Laboratory of Nuclear Science. This diffractometer in cooperation with the pulsed neutron source produced by an electron linear accelerator made it possible to make the neutron diffraction study of the ^{157}Gd compounds which have been known as the best absorber of the thermal neutrons. The results of the neutron diffraction from a single crystal of $Gd_{0.9}-Y_{0.1}$ have indicated that the nuclear scattering amplitude b of ^{157}Gd is independent of the wavelength except the resonance scattering regions, which assures that this technique can be used to determine the crystal and magnetic structures of ^{157}Gd compounds. (auth)

33925 METALLURGICAL ASPECTS AND MAGNETIC CHARACTERISTICS OF Sm-Co-Cu TERNARY SYSTEM. Rim, C. Los Angeles; Univ. of Southern California (1974). 131p. University Microfilms Order No. 75-6440.

Thesis (Ph. D.).

The $Sm_2(CoCu)_{17}$ system has been studied to seek a better understanding of the interrelationships existing between the metallurgical structures and ferromagnetic properties, particularly coercivity. Results of comparison of the bulk and powder coercivity of annealed specimens indicate that the phase boundary is a nucleation center for reverse domain creation when the magnetization is reversed. This is verified by the direct observation of domain creation and growth at phase boundaries in a magnetization experiment. In the cast material, on the other hand, the coercivity is largely influenced by domain wall pinning at the grown-in dislocation site. This conclusion is derived indirectly from the observed variation in microhardness in relation to the extrinsic and intrinsic magnetic parameters. (Diss. Abstr. Int., B)

33926 TENSILE PROPERTIES TO 550°C AND MICROSTRUCTURES IN QUENCHED AND AGED Ti-6Al-2Sn-4Zr-6Mo ALLOY. Mendiratta, M. G. (Systems Research Labs., Inc., Dayton, OH); Roberson, J. A. Met. Trans.; 6A: No. 4, 940-943 (Apr 1975).

The tempering behavior of orthorhombic martensite in Ti-6246 alloy was studied. Quenching of this alloy from 950°C to room temperature produces a microstructure containing mostly orthorhombic martensite and small amounts of retained β. Aging at 550°C then precipitates very small β particles in the martensite plates; the orthorhombicity of the martensite lattice is lost, and the crystallography of β precipitation follows the well-known $\alpha \rightarrow \beta$ Burger's relationship. The precipitation of β particles makes the alloy very hard and inductile and also very strong at 550°C. In addition, the aging process precipitates α particles in the retained β. (auth)

33927 GRAIN BOUNDARY EMBRITTLEMENT IN A BETA Ti ALLOY. Rack, H. J. (Sandia Labs., Albuquerque, NM). Met. Trans.; 6A: No. 4, 947-949(Apr 1975).

Maximum dynamic fracture toughness in solution treated RMI 38644 is observed with lower solution treatment temperatures and faster cooling rates. The lower treatment temperatures prevent rapid grain growth and minimize quasicleavage and cleavage failure. Apparently faster cooling rates also suppress the Ti and Cr segregation to and V and Mo segregation away from the beta grain boundaries which occurs if the alloy is slowly cooled from the solution treatment temperature. (auth)

33928 CREEP BEHAVIOR OF Ni-W SOLID SOLUTIONS. Mohamed, F. A.; Langdon, T. G. (Univ. of Southern California, Los Angeles). Met. Trans.; 6A: No. 4, 927-928(Apr 1975).

The creep behavior of solid solution alloys generally falls into one of two possible classes. Class I alloys exhibit steady-state creep rates which vary with stress raised to a power close to 5, whereas in class II alloys the stress exponent for steady-state creep is close to 3. By making assumptions concerning the nature of the rate-controlling deformation mechanisms in the two alloy classes, a criterion was recently developed to distinguish between class I and class II behavior. The three investigations reported to date for Ni-W solid solutions show creep behavior that is consistent with this criterion, and do not substantiate the suggestion that a stress exponent of 3 may not necessarily signify class II behavior. (PMA)

33929 EFFECT OF LOW MELTING POINT PHASES ON THE ELEVATED TEMPERATURE MICROSTRUCTURAL STABILITY OF HOT PRESSED Be. Webster, D. (Lockheed Missiles and Space Co., Inc., Palo Alto, CA). Met. Trans.; 6A: No. 4, 803-808 (Apr 1975).

The factors governing the growth of BeO particles and beryllium grains in hot-pressed beryllium block were studied. The size of BeO particles was found to increase as the aluminum, magnesium and silicon contents were raised. Higher processing temperatures during manufacture also increased the size of the oxide. Silicon doping of the beryllium powder before pressing was found to be a particularly effective way of increasing BeO particle size. The pressure-temperature cycle employed during hot pressing was also found to affect the oxide morphology. Cycles that produced full density at the lowest temperature minimized the extent of oxide agglomeration. Diffusion of aluminum and a combination of aluminum, silicon and iron into high purity beryllium at 1366 K produced a grain boundary liquid phase which resulted in an accelerated grain growth rate and BeO agglomeration. (auth)

33930 CREEP OF UDIMET 500 DURING THERMAL CYCLING. II. The Time to Failure. Weiss, I. (McGill Univ., Montreal); Rosen, A.; Brandon, D. G. Met. Trans.; 6A: No. 4, 767-772(Apr 1975).

The effect of rapid temperature cycling on the time to failure of Udimet 500 superalloy was investigated. The time to failure is determined only by the minimum creep rate and not by the thermal history. For this reason the time to failure under thermal cycling conditions is longer than the time to failure calculated from isothermal data. (auth)

33931 CREEP OF UDIMET 500 DURING THERMAL CYCLING. I. The Minimum Creep Rate. Weiss, I. (McGill Univ., Montreal); Rosen, A.; Brandon, D. G. Met. Trans.; 6A: No. 4, 761-766(Apr 1975).

The effect of rapid temperature cycling on the minimum creep rate of Udimet 500 superalloy was investigated. An abrupt temperature decrease during creep is followed by a delay period of zero creep rate. Due to this delay period, the creep rate under thermal cycling conditions is lower than the creep rate calculated from the steady state creep rate at constant temperature. (auth)

33932 THE EFFECT OF HEATING AND COOLING ON THE TRANSITION FROM THE TRANSCRYSTALLINETO INTERCRYS-

TALLINE FRACTURE OF LOW ALLOYED MOLYBDENUM ALLOYS. Drachinskij, A. S.; Pisarenko, V. A.; Trefilov, V. I. (AN Ukrainskoj SSR, Kiev. Inst. Metallofiziki). Probl. Prochnosti; No. 4, 54-57(Apr 1974). (In Russian).

For English translation see the journal Strength Mater.

Fracture stress was investigated as a function of grain size in addition to the change in type of fracture of low-alloyed molybdenum after annealing in an electric furnace in a vacuum. It is shown that fast electrical heating and rapid cooling decrease the tendency of molybdenum alloys for brittle fracture along the grain boundaries, and for a number of alloys intercrystallite fracture is completely suppressed. Possible reasons leading to the change in kind of fracture are discussed. (tr-auth)

33933 CHEMICAL AND STRUCTURAL HETEROGENEITY AND MECHANICAL PROPERTIES OF WEAR RESISTANT ALLOYED WELDING DEPOSITS. Grinberg, N. A.; Dzykovich, I. Ya. (AN Ukrainskoj SSR, Kiev. Inst. Ehlektrosvarki); Nikolaenko, M. P. Svar. Proizv.; No. 3, 7-9(Mar 1974). (In Russian).

For English translation see the journal Weld. Prod.

It is shown that alloying of chromium-carbon alloys with boron increases the chemical and structural inhomogeneity of the alloy and of separate layers of the weld metal, and the amount of eutectic and of excess phases enriched in chromium and manganese, and decreases the diffusion of chromium and manganese in the main metal. In this case the wear resistance of the alloys increases significantly, and the brittleness and tendency to hot cracking are increased. An increase in the content of carbon and chromium in the alloy promotes the chemical and structural phase inhomogeneity of weld metal, and decreases the resistance of the alloys to shock. The wear-resistance of these alloys increases, but less intensively than on alloying with boron. Alloying of chromium-carbon seam metal with nickel and manganese increases the stability of austenite and increases the resistance of the metal alloys to shock. (tr-auth)

33934 ORIENTATION SLIP CHARACTERISTICS DURING THE MOLYBDENUM MONOCRYSTALS CREEP IN 800 TO 1800°C TEMPERATURE RANGE. Zasimchuk, E. E.; Krivenyuk, V. V.; Marusij, O. I. (AN Ukrainskoj SSR, Kiev. Inst. Problem Prochnosti). Probl. Prochnosti; No. 4, 57-62(Apr 1974). (In Russian).

For English translation see the journal Strength Mater.

Orientation slip characteristics were investigated during high-temperature creep at temperatures of 800 to 1800°C. The orientation of the strain axis was (112), (110). It was established that during high-temperature elongation, glide begins along plane systems of the type (321) in the direction (111). The effect of the orientation factor on the true tangential stress in planes of the type (321) is shown. For the orientation (321) the value of unit stress τ in the (321) plane is significantly less than in the same plane for a (110) orientation. This behavior apparently explains the substantial difference in creep rates of differently oriented crystals under the same conditions of testing. The stability of the (110) elongation axis during creep is shown. (tr-auth)

33935 ALLOY CHEMISTRY OF SIGMA(β-U)-RELATED PHASES. IV. A15, Sigma and Chi' Phases in Ternary Alloys of Refractory Metals with Gallium. Orillion, M. T.; Raman, A. (Louisiana State Univ., Baton Rouge (USA). Materials Group). Z. Metallk.; 65: No. 11, 709-713(Nov 1974).

Ternary vanadium-, niobium-, and tantalum-rich alloys containing gallium were studied to establish the mutual solid solubilities of high temperature, high field superconductive A15 phases. The A15 phases Nb_3X and V_3X were found to form uninterrupted series of solid solutions with each other. Two A15 phases were encountered in solid solution alloys at the middle of the sections V_3Si-V_3Sn, V_3Ga-V_3Sn, Nb_3Ge-Nb_3Sn, and Nb_3Sn-V_3Si. Dendrites were noted in some of these alloys and it is possible that dendritic segregations cause two A15 phases to be present in the same solid solution alloy. Six new ternary sigma-phases, encountered in the Nb-X-Ga (X = V, Cr, Mn, Fe, Co, and Ni) systems, are characterized. These sigma-phases have a structure similar to Nb_2Al(sigma), and possess r_A/r_B close to 1.09. It is postulated that sigma-phases with non-transition elements are stable when r_A/r_B is close to 1.00 if two or more atom-kinds are present at the A-sites, and when r_A/r_B away from 1.00 (close to 1.08) if two or more atom-kinds are located at the B-sites. A primitive cubic structure, designated as chi', was found to occur in the alloys near the compositions Nb_4XGa(X = Ni and Cu) and Ta_4XGa(X = Cr, Fe, Co and Ni). Its structure is possibly related to the structure of the chi-phases with the α-manganese structure. (auth)

33936 USE OF MODULATED MOLECULAR BEAMS IN STUDYING ABSORPTION PHENOMENA. Starodubtsev, S. V. pp 77-89 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

A substance is heated in a furnace to give a certain vapor pressure of atoms or molecules that can be ionized on an incandescent surface of a metal wire. Two diaphragms define a narrow beam that can be interrupted mechanically by a rotating disk with slits or by a vibrating plate. Thus the atoms or molecules of the beam are exposed to the incandescent wire for a certain time Δt_1. Access to the wire is interrupted for a time Δt_2. The sum $\Delta t_1 + \Delta t_2 = \tau$ determines the modulation period of the beam. Surface ionization of the atoms or molecules creates an ion current from the wire to a receiving electrode having a negative potential. The ion current is modulated with the same frequency $\nu = 1/\tau$ with which the molecular beam is modulated. However the form of the modulated ion current and the amount of modulation will not be the same as in the molecular beam. By an oscillographic study of the ion current it is possible to determine the "life time" of the adsorbed atoms and the heat of absorption. The quantitative relations are examined in detail. Experimental results are described for the desorption of Na and K from tungsten wire at various temperatures. (SJR)

33937 EMISSION OF POSITIVE IONS BY INCANDESCENT OXIDES OF TITANIUM, ZIRCONIUM, AND SILICON. Starodubtsev, S. V.; Timokhina, Yu. I. pp 90-96 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

In these experiments, oxide powders of SiO_2, TiO_2, and ZrO_2 were pressed into tungsten wire spirals 0.3 mm in diameter with a cross section of 3 mm^2 and 20 to 25 windings and a gap of 0.1 mm between the windings. The spiral was heated electrically in a vacuum of 10^{-6} mm Hg std with the temperature being measured with an optical pyrometer. Ions from the spiral are accelerated by an electric field to 1500 v. The ion beam passing through a slit in the collector can be analyzed by means of a mass spectrometer. The ion current from the spiral is measured by a galvanometer having a sensitivity of 7.9×10^{-10} a. The positive ion current is determined by an electrometer. With TiO_2, impurities of Na^+, K^+, $H_2O_2^+$, and Ca^+ appear first, and are followed by a Ti^+ peak at 1600°C and a TiO^+ peak at 1900 to 2000°C. Then contributions from neutral Ti, TiO, and TiO_2 begin to appear and increase. Optimum operating conditions as a source of Ti^+ ions are attained at T = 1000°C after incandescence at ~2000°C. With ZrO_2 the current of Zr^+ ions attained a value of 4×10^{-6} a at 2200°C. The molecular ions ZrO^+ and ZrO_2^+ are also observed. With SiO_2 the total current of Si^+ ions was 2×10^{-7} a with stable operation. Emission of Si^+ and SiO^+ ions begins at 1900°C. Lead oxide decomposed to lead metal that covered the walls of the vessel. (SJR)

33938 SURFACE IONIZATION OF MAGNESIUM ON INCANDESCENT TUNGSTEN. Starodubtsev, S. V.; Timokhina, Yu. I. pp 99-111 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

By magnetic analysis of the ions it was possible to take into account the effect of molecular beam contamination with alkali metal elements and to investigate the ionization of a number of different kinds of atoms on the same incandescent wire. Significant ionization of Mg on tungsten was detected. Ionization of Mg on tungsten covered with magnesium and tungsten oxides takes place even at low temperatures of ~1200°K. Incandescence of oxidized wires at high temperatures T = 2000°K stabilizes the ion emission. On heated wires, ionization of Mg is observed only at high temperatures. It was found that pure magnesium contains traces of alkali metal contaminants which give a noticeable emission of sodium ions. On investigating the ion current as a function of temperature it was found that the ionization coefficient of Mg obeys an exponential law: $n^+/n_0 = A \exp(-\phi\epsilon/kT)$, where $\phi \approx 2.8$ v is close to the difference in ionization potential and work function of pure tungsten. The absolute value of the ionization potential is a number of orders of magnitude greater than the theoretical value. Magnesium possesses metastable levels that could explain the anomalously high values of the ionization potential of Mg. (SJR)

33939 ENERGY BALANCE DURING SECONDARY PROCESSES. Arifov, U. A.; Ayukhanov, A. Kh.; Starodubtsev, S. V.; Nosenko, B. M. pp 160-164 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

The energy in the primary ion beam is equated to the energy carried off by secondary scattered ions, the energy carried off by primary beam ions neutralized at the moment of collision, and the energy dissipated in the target. As a result of ion scattering the target absorbs only a part of the energy in the primary ion beam, which is designated as an accommodation coefficient D. Experi-

ments on bombarding W, Ta, and Mo surfaces with Cs and Rb ions indicate that the energy carried off in the form of neutral particles can be neglected. If the volt-ampere characteristics of the secondary ion beam are known, the scattering energy E_{scat}, and also the accommodation coefficient D can be determined. Calculations show that the value of the accommodation coefficient D is ~0.9 with about 10% of the total energy being carried off in the form of scattered ions. (SJR)

33940 ABSORPTION AND IONIZATION OF SODIUM ON HOT TUNGSTEN. Romanov, A. M.; Starodubtsev, S. V. pp 164-179 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

Experiments were run on the absorption and ionization of sodium metal on tungsten surfaces. A mass analysis of sodium samples being used showed that the increase in ion current over calculated values cannot be explained by contamination of the sodium beam with extraneous alkali metals. Hence it is necessary to assume that the observed features of the absorption and ionization of sodium are caused by surface inhomogeneity. The reason for the anomalous course of the ion current could be a result of the presence of oxygen spots on the tungsten. It is shown from the magnitude of the electron current and from the change in the average apparent work function that the minimum degree of oxygen coverage that could be detected did not exceed 0.01. It is concluded that the role of oxygen spots was generally not significant. In order to understand the features of the absorption and ionization of sodium on tungsten it should be kept in view that surface inhomogeneity has a different effect with respect to adsorption and ionization of sodium. The sections on which sodium atoms are strongly bound are not active with respect to ionization, and migrate to free, active areas by surface diffusion. Sections with a rough surface fill with sodium atoms first, and flow to adjacent areas. (SJR)

33941 ION SCATTERING COEFFICIENT AS A FUNCTION OF THE MASS RATIO OF THE COLLIDING PARTICLES. Arifov, U. A.; Ayukhanov, A. Kh.; Starodubtsev, S. V. pp 179-185 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

A study was made of the scattering of positive cesium ions on nickel, where the ionization potential of the cesium ion is less than the work function of the nickel target, and of the scattering of barium ions on molybdenum, where the ionization potential of the barium ion is greater than the work function of the Mo target. The experimental results show that the secondary ion emission from a pure nickel target bombarded with positive cesium ions at 1350°C consists of evaporated (86%) and diffused (14%) secondary ion currents. Scattered and evaporated cesium atoms are almost completely lacking. These secondary ions had penetrated into the depth of the target, and then as a result of thermal motion at high temperature they were evaporated from the surface. On bombarding a clean molybdenum surface with 560 eV barium ions at a temperature of 300°C, the secondary ion emission was found to be very small (<1% of the primary beam). The secondary ion emission can be understood as a process of multiple individual collisions of ions with target atoms after penetrating deep into a target. (SJR)

33942 ROLE OF SURFACE INHOMOGENEITY DURING ADSORPTION AND IONIZATION OF SODIUM AND LITHIUM ON TUNGSTEN. Romanov, A. M.; Starodubtsev, S. V. pp 185-202 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

The atomic structure of the tungsten surface determines the existence of preferred directions of surface diffusion of lithium and sodium adatoms. The probability of adatom diffusion on a given face is calculated for Li and Na adatoms. The greatest Na diffusion should be observed between areas on the (110) face and also between holes of the (110) face and the saddles of (122), (012), and (112) faces. Lithium and sodium atoms are most strongly bound on tungsten faces having a wrinkled structure. Surfaces on which the Na and Li atoms are most strongly bound are not "active" with respect to ionization. Hence dilute layers (phases) can exist on sections with one structure, and concentrated layers (phases) can exist on sections with another structure. This behavior presumes a certain sequence in filling the surface with adatoms. The order of filling of various faces of the tungsten crystal with Na and Li adatoms is discussed. (SJR)

33943 MAGNETIC PROPERTIES AND PRESSURE DEPENDENCE OF THE CURIE TEMPERATURE OF $LaCo_{5x}Cu_{5-5x}$. Brouha, M.; Buschow, K. H. J. (Philips Research Labs., Eindhoven, Netherlands). J. Appl. Phys.; 46: No. 3, 1355-1358(Mar 1975).

The magnetic properties of the series $LaCo_{5x}Cu_{5-5x}$ were studied. All compounds were found to crystallize in the hexagonal $CaCu_5$ structure type. As a function of composition x the following properties were determined: the lattice constants, the Curie temperatures and their pressure dependence up to 40 kbar, the anisotropy fields, the saturation moments at 4.2°K, and the initial compressibilities. Attempts have been made to explain the variation of the magnetic properties in terms of the collective electron model with a 3d band shape that depends on Cu concentration, taking account, however, of a certain extent of localization of the 3d electrons. (auth)

33944 OXYGEN ADSORPTION ON CLEAN Mo(100) SURFACES. Riwan, R.; Guillot, C.; Paigne, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Atomique). Surface Sci.; 47: No. 1, 183-190(Jan 1975).

From 3rd international symposium on surface physics; Utrecht, The Netherlands (26 Jun 1974).

Oxygen adsorption on clear Mo (100) surfaces was studied by LEED, AES, work function changes, and energy loss spectroscopy. At room temperature, the oxygen uptake as determined by AES is linear up to one third of the saturation value. Data obtained with CO adsorption were used to determine the oxygen coverage. With increasing oxygen exposure LEED shows three stages: a c (2 × 2) phase growing simultaneously with a (6 × 2) structure, a stage with (110) microfacets covered by two-dimensional structures and finally a p (3 × 1) structure together with a p (1 × 1) structure, probably due to an oxide phase. Even in the low temperature range (370−500 K) remarkable effects are observed: adsorption at 370 K produces a disordered c (4 × 4) structure which is followed by a $(\sqrt{5} \times \sqrt{5})$-R 26° 33 structure. The same occurs when the initial c (2 × 2) structure formed at 295 K is heated above 370 K. Measurements of the work function indicate a minimum at the end of the c(2 × 2) structure, then a rapid increase and at saturation a value of about 1.5 V above that of the clean surface. Energy loss spectroscopy measurements point to an increase of the surface plasmon energy during the faceting stage. New transitions were observed which are due to new electronic levels induced by the adsorption. They are compared with photoemission results on W and Mo. (auth)

33945 QUANTITATIVE ASPECTS OF ION SCATTERING SPECTROSCOPY (ISS). Niehus, H.; Bauer, E. (Physikalisches Institut, Technische Universitaet Clausthal, Clausthal, F. R. Germany). Surface Sci.; 47: No. 1, 222-233(Jan 1975).

From 3rd international symposium on surface physics; Utrecht, The Netherlands (26 Jun 1974).

The application of ion scattering spectroscopy (ISS) as a tool for the analysis of the surface composition of solids has been hampered to date by the need of special equipment and the lack of understanding of the interaction processes between ions and surfaces. The purpose of this paper is to examine what information can be extracted from the experimental data and to show that ISS can be easily combined with AES and LEED in the same UHV system. The commercial cylindrical Mirror Analyzer (CMA) for the AES measurements was simply switched in situ to ISS by reversing the polarity of the deflection voltage. The surface studied was W(110) surface either clean or covered with an electronegative (oxygen) or an electropositive (beryllium) adsorbate in the coverage range from 0 to 1 monolayer. He^+ scattering in the energy range from 300 to 1000 eV shows that ISS at present is better suited as a tool for surface structure analysis than for the determination of the species and quantity of adsorbed atoms. (auth)

33946 RELAXATION CRACKING IN STEEL ASTMA 508/Cl. 2. Lorenz, M. pp 39-46 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

Relaxation embrittlement, the origin of underclad cracks, can be traced to two distinct effects. The first is a general sensitivity or susceptibility to grain hardening and microdeformation instability of the type of steel whose composition is between that of pure carbon steel and definite heat-resistant steels. The susceptibility increases with the content of carbide-forming elements. The second is a sensitization from trace elements which collect at the austenite grain boundaries because of their low solubility in the superheated coarse grains of the welding-affected zone. The material is weakened due to this grain boundary segregation. Experimental results confirming these conclusions are reported for two steels. (JSR)

33947 STRUCTURE AND PROPERTIES OF STAINLESS STRIP CLADDINGS ON PRESSURE VESSEL STEELS. Vartiainen, K.; Hakala, J. pp 83-89 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

Cladding by overlay welding was carried out on a Cr–Mo–V steel, ASTM-A533, and a C–Mn microalloyed steel, with strip electrode compositions of 24Cr–13N; and 18Cr–12Ni–3Mo. Despite a low δ-ferrite content, the cladding materials did not show any tendency to hot cracking. The base materials were not susceptible to underclad cracking due to: (1) the normalizing caused by the welding heat from the second layer; (2) the high chromium content in Cr–Mo–V steel; and (3) the relatively low impurity content of all steels. A brittle martensitic structure was formed in the first cladding layer, whether it was welded by 18/12/3 or 24/13 strip. This martensite can, however, be made ductile with a stress relief heat treatment. The formation of the martensite was mainly caused by the inhomogeneous dilution of the cladding material with the base metal. The formation of martensite can be diminished by stabilizing the arc, and by using those welding parameters which result in a small penetration. The corrosion resistance of the one layer claddings was poor due to the low-chromium martensite. In severe service conditions, multi-layer claddings should always be used. (PMA)

33948 PROPERTIES OF TYPE X6 CrNi18 11 STAINLESS STEEL AND PARENT-LIKE WELD JOINTS WITH REGARD TO ELEVATED TEMPERATURE APPLICATION. Grosser, E. D.; te Heesen, E.; Lorenz, H. pp 187-194 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The high temperature properties of the unstabilized, austenitic X 6 CrNi 18 11 stainless steel were evaluated experimentally. The mechanical properties of the steel after cold working and the effect of the cooling rate on the intercrystalline corrosion were determined and shown graphically. The structural stability and structural changes during extended annealing were described. The short-term mechanical characteristics, including strength, elongation fracture, tensile strength, and notch impact strength were examined and the results are graphed. The creep stress and thermal embrittlement of the steel were also determined for the short-term. The long-term stability and strength of the steel and welded joints were examined. Fatigue and fracture mechanical tests were also made. (JSR)

33949 EVALUATION OF MATERIAL PROPERTIES BY MEANS OF THERMOELECTRIC MEASUREMENTS. Hoffmeister, H.; Austel, W. pp 263-265 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

Studies were made on the hardened steels C 22, 22 NiMoCr 37, and 21 NiCrMoV 47 to determine if the measurement of the actual and the continuously possible integral thermo emf was a valid method for the non-destructive monitoring of reactor construction material. The principles and techniques of the method to be used during annealing were outlined. Test results were shown graphically. A correlation was made between the hardness and the actual thermo emf. Studies must still be made on the effects of neutron irradiation and mechanical stresses to determine if the method can be used for the monitoring of reactor construction material during reactor operation. (JSR)

33950 INSERVICE REACTOR REPAIR SIMULATION. Binkley, N. C.; Herrmann, R. W. pp 289-298 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

Two welds in ASTM-A533-B steel were made and tested in a simulated inservice reactor repair. Results indicated that the weldments had excellent mechanical properties in the absence of postweld heat treatment. The weldments exhibited good tensile strengths and bend ductilities and excellent impact strength, even at temperatures as low as −21°C. Peak residual stresses approached 415 MN/m^2 tension at the weld surface centerlines and very rapidly dissipated to nearly zero at points only a few centimeters to either side of the welds. The residual stress distribution through the thickness of the repaired plate, at the longitudinal axis of the weld, went from maximum tension at the weld surface to maximum compression at the bottom of the weld deposit, returnint ot a less than maximum tension value at the bottom of the plate, under the weld. In all cases, residual stress gradients were quite slight. (PMA)

33951 STRUCTURE AND CRITICAL CURRENT OF THE SUPERCONDUCTING ALLOY Zr–20% Nb. Vozilkin, V. A.; Bychkov, Yu. F.; Zuev, M. T.; Buinov, N. N. (Inst. of Metal Physics, Moscow). Fiz. Metal. Metalloved.; 38: No. 6, 1228-1234(Dec 1974). (In Russian).

The form, dimensions, orientation, and character of the distribution of dispersed inclusions of the ω and α phase were studied during the thermal processing of recrystallized and cold-worked β phase samples using transmission electron microscopy and microdiffraction of thin foils. The changes of the microstructure were compared with changes of the magnitude of the critical density of the superconducting current i_c and the form of the relation $i_c = f(H)$ at 4.2°K and i4H. (tr-auth)

33952 ORIENTATION OF THE MAGNETIC FIELD AND DIMENSIONAL EFFECTS IN HARD SUPERCONDUCTORS. Chizhov, A. Kh.; Stovbur, V. I. (Ioffee Inst. of Physics and Tech., Leningrad). Fiz. Metal. Metalloved.; 38: No. 6, 1179-1185(Dec 1974). (In Russian).

On the basis of the study of seven groups of cylindrical samples of Pb–Bi alloy with different wall thicknesses ω it was shown that the orientation of the magnetic field does not affect the basic relations of the dimensional dependence of the magnetic character of hard superconductors. It was established that the parameters α, B_0, and A of the Kim model are dimension-dependent values whose dependence on ω has the form of two regions very different from each other. At $\omega > \omega_c$ the parameters α and B_0 are constants but the value of $A \gg 1$; at $\omega < \omega_c$ α and B_0 are linearly decreasing functions of ω. The inclination and point of inflection of ω_c (of the order of 1 mm) strongly depends on the structure. The character of these dependences is shown. In these cases the functions of ω and other magnetic characteristics (H_p and H_1) can be approximated by two forms of dependence. The orientations of the magnetic field change quantitatively the magnetic characteristics of hard superconductors, whose dependence on the angle between the direction of the field and the axis of the sample is close to sinusoidal. (tr-auth)

33953 STRUCTURE OF ALLOYS OF THE NIOBIUM–TITANIUM–ZIRCONIUM SYSTEM. Effect of Gaseous Impurities on the Structural Changes During Thermal Processing. Lyasotskii, I. V.; Tyapkin, Yu. D.; Meshkova, V. E. (Inst. of Metal Science and Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 38: No. 6, 1282-1293(Dec 1974). (In Russian).

The structure of alloys of the Nb–Ti–Zr system, containing gaseous impurities, was studied by electron microscopic and x-ray methods after thermal processing of the samples in the interval from 500 to 600°C. The relation of the alloy structure with the crystal-geometric ratios of the matrix lattice and precipitation (gas incorporation) was established. The precipitation depends on the concentration of Zr in the alloy. (tr-auth)

33954 STABILITY OF ω-MODIFICATION OF TITANIUM AND ZIRCONIUM. Bychkov, Yu. F.; Likhanin, Yu. N.; Mal'tsev, V. A. (Moscow Engineering-Physics Inst.). Fiz. Metal. Metalloved.; 38: No. 6, 1294-1296(Dec 1974). (In Russian).

In order to compare data on the stability of the ω phases of Ti and Zr, the stability of ω-Ti was studied under the same conditions as that used previously for the study of ω-Zr. The samples were remelted in an arc furnace and then subjected to hydrostatic pressure of 100 kbar at room temperature. X radiographic studies and measurements of the physical properties of the ω modification were made. Heating at 250°C completes the $\omega \rightarrow \alpha$ transition, whereas in Zr the sample must be heated to 380°C. The change in the microhardness and phase composition during plastic deformation was determined and the results showed that the stability of ω-Zr under these same conditions is higher than that of ω-Ti. (JSR)

33955 DIFFUSION OF TRITIUM INTO MOLYBDENUM AT TEMPERATURES OF 150 TO 550°C. Maksumov, T. M.; Petushkov, E. E. (Inst. of Electronics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 9, 32-34(1974). (In Russian).

A method for the determination of the spatial distribution of tritium in Mo is described. The sample studied is annealed in a tritium atmosphere at 150 to 550°C and then rapidly cooled. The distribution of tritium within the sample is analyzed by the layer stripping method. The activation energy for the diffusion process was calculated as 15,000 cal/mol, in comparison with previously obtained value of 14,000 cal/mol. (JSR)

33956 ROOM TEMPERATURE TENSILE PROPERTIES OF TITANIUM AND SEVEN TITANIUM ALLOYS PREPARED BY SKULL CASTING. Calvert, E. D.; Lowery, R. R. Washington, DC; Bureau of Mines (1974). 26p.

The room temperature tensile properties of commercially pure Ti and seven Ti alloys prepared by skull casting were determined

in the as-cast and heat treated conditions. Data were compared with property data from tensile tests on wrought alloys of the same compositions in the as-worked and heat treated conditions. The alloys evaluated were Ti–5Al–2.5Sn, Ti–6Al–4V, Ti–6Al–5V–1Si, T–6Al–2Sn–4Zr–2Mo, Ti–6Al–6V–4Zr–4Mo, Ti–6Al–6V–2Sn and Ti–11.5Mo–6Zr–4.5Sn. The data indicate that the α and α–β alloys have strength properties in the as-cast condition that are reasonably close to the strength properties of their wrought counterparts in the as-worked condition. Fine-grained cast structures of β III (Ti–11.5Mo–6Zr–4.5Sn) were shown to be generally stronger in the as-cast condition than the wrought alloy in the as-worked condition except for the yield strength of one structure that was unusually low. Indications are that optimization of heat treatment parameters for each cast structure could produce strength properties equal to that of wrought materials. (Metals Abstr.)

33957 EXPERIMENTAL PROOF OF MAGNETIC BREAKDOWN COHERENCY IN BERYLLIUM. Alekseevskii, N. E.; Nizhankovskii, V. I. (Inst. of Physics Problems, Moscow). Fiz. Metal. Metalloved.; 38: No. 5, 1105-1108(Nov 1974). (In Russian).

The diagonal elements of the tensor of magnetic resistivity ρ_{xx} and ρ_{yy} were simultaneously measured on S-shaped samples of Be for different angles of declination of the hexagonal angle of the sample to the magnetic field. The angular dependence of the phase difference between the oscillations ρ_{xx}^{ω} and ρ_{yy}^{ω} was measured for magnetic fields of 55 and 86 kOe. It was concluded that the detection of the angular dependence was convincing experimental proof of the coherence of the magnetic breakdown in Be. (JSR)

33958 EFFECT OF QUENCHING ON THE ANISOTROPY OF THE RESISTANCE TO PLASTIC DEFORMATION IN BERYLLIUM SINGLE CRYSTALS. Gindin, I. A.; Laptev, I. N.; Neklyudov, I. M. (Physical-Technical Inst., Kharkov). Fiz. Metal. Metalloved.; 38: No. 5, 1116-1119(Nov 1974). (In Russian).

Quenching of Be single crystals at 1150°C sharply increases the critical shearing stress along the basal plane and to a less degree along the prismatic plance. This causes a decrease of the anisotropy of the resistance to plastic deformation. (JSR)

33959 DYNAMIC THEORY OF THE COEXISTENCE OF SUPERCONDUCTIVITY AND FERROMAGNETISM. III. Role of Low-Frequency Modes. Izyumov, Yu. A.; Skryabin, Yu. N. (Inst. of Metal Physics, Moscow). Fiz. Metal. Metalloved.; 38: No. 5, 912-917(Nov 1974). (In Russian).

The general structure of the equation for the Green function of superconductivity is discussed with consideration of the interaction of electrons with the magnetic modes. The effect of the low-frequency mode on the temperature of the superconducting transition T_c was studied. It was shown that as a result of the dispersion relation for the Green function the contribution of the low-frequency phonons is completely separated out of the equation determining T_c whereas the contribution of the low-frequency magnetic mode is finite and can be simply considered. The difference in the effect of the low-frequency phonons and the magnetic mode on T_c is shown in the Anderson-Maki theorem. It was shown that for metals with a magnetic order of any type under the condition that $T_k \lesssim T_c$, where T_k is the magnetic transition temperature, the quasistatic approximation is valid. (tr-auth)

33960 EFFECT OF ADDITIONS OF YTTRIUM AND LANTHANUM ON THE STRUCTURE AND PROPERTIES OF CAST MOLYBDENUM. Belous, O. A.; Zhomov, F. I.; Maslov, V. P.; Minakov, V. N.; Trefilov, V. I.; Fedorov, G. B. (Moscow Engineering-Physics Inst.). Dokl. Akad. Nauk SSSR; 220: No. 3, 568-570(21 Jan 1975). (In Russian).

The effect of additions of Y and La on the distribution of C in cast Mo was studied by the autoradiographic method using ^{14}C. Results show that the improvement of the low-temperature ductility of cast Mo, observed during microalloying with Y and La, is explained both by the purification of the matrix of impurities and by their favorable redistribution (particularly C) in the ingot. (JSR)

33961 FORM OF CARBIDES AND OXIDES IN CAST TUNGSTEN. Savitskii, E. M.; Burkhanov, G. S.; Kirillova, V. M. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 220: No. 3, 586-587(21 Jan 1975). (In Russian).

The form, dimensions, and distributions of carbides and oxides in cast W was studied by fractographic methods using an optical microscope and a scanning electron microscope. The carbides are either coarse conglomerates of dendrites or colonies of sheet-like inclusions, depending on the C concentration. The oxides, at low oxygen concentrations, crystallized on the surface of the metal crystals in the form of fine ellipsoidal films. With increase of the oxygen concentration the dimension of the grains of the film increase. These results are compared with those obtained in cast Mo. (JSR)

33962 ELECTRON WORK FUNCTIONS AND SURFACE TENSION OF GALLIUM–INDIUM AND GALLIUM–BISMUTH BINARY SYSTEMS. Khokonov, Kh. B.; Zadumkin, S. N.; Alchagirov, B. B. (Kabardino-Balkarskij Gosudarstvennyj Univ., Nal'chik (USSR)). Elektrokhimiya; 10: No. 6, 911-916(Jun 1974). (In Russian).

For English translation see the journal Sov. Electrochem.

The electron work function, surface tension, and density of the liquid binary system Ga–In and Ga–Bi were measured in all composition intervals in the temperature range from liquefaction up to 500°C. Density polytherms of the pure metals and all the alloys studied were represented by straight lines. Polytherms of the surface tension of some alloys and isotherms of the surface tension for both systems were given. The following values of the electron work functions were obtained: 4.35 ± 0.05 eV for Ga at 200°C, 4.08 ± 0.04 eV for In, and 4.34 ± 0.05 eV for Bi at 300°C. (tr-INIS)

33963 MECHANISM OF JUMP-LIKE MAGNETIC REVERSAL OF $SmCo_5$ AND $GdCo_5$ SINGLE CRYSTALS. Ermolenko, A. S.; Korolev, A. V.; Lagunova, V. I.; Shcherbakova, E. V. (Inst. of Metal Physics, Moscow). Fiz. Metal. Metalloved.; 38: No. 5, 1001-1011(Nov 1974). (In Russian).

The dependence of the field H_c, in which jump-like magnetic reversals occur in spherical single crystals of $SmCo_5$ and $GdCo_5$, on the dimension of the sample, the temperature, and the intensity of the magnetizing field was studied. The effect of the defects artificially produced on the surface of the sample on the size of H_c was also studied. It was shown that the value of H_c was determined by the field for the initiation of nucleation, present in the sample at the moment of its magnetic reversal. (tr-auth)

33964 PROCESS OF TRANSFER OF VANADIUM FROM VANADIUM CARBIDES INTO AUSTENITE. Gervas'ev, M. A.; Gol'dshtein, M. I.; Panfilova, L. M.; Rudenko, V. K. (Ural Polytechnical Inst., Sverdlovsk, USSR). Fiz. Metal. Metalloved.; 38: No. 5, 1038-1043(Nov 1974). (In Russian).

The process of the transfer of V from the carbide into the austenite steels 40, 40Kh2, and 40S2 was studied. The carbide–steel pairs, obtained by diffusion welding, were annealed in a vacuum furnace at different temperatures and for different lengths of time. The diffusion coefficient of V into the austenite and the values of the concentration of V in austenite at the boundary with the carbide were determined. The effect of the composition of the austenite on the process of V transfer from the carbide into the solid solution was investigated. (tr-auth)

33965 EFFECT OF ELECTRON–ELECTRON COLLISIONS ON THE HEAT CONDUCTIVITY OF METALS. Ermolaev, A. M.; Fal'ko, I. I. (Kharkov State Univ.). Fiz. Metal. Metalloved.; 38: No. 5, 1089-1090(Nov 1974). (In Russian).

Equations are derived showing that the dynamic character of the shielding of the electron Coulomb interaction by ions affects the heat resistivity of metals. The results obtained can be applied to the interpretation of experimental data. (JSR)

33966 MOESSBAUER STUDY OF THE COMPOUND $SmCo_4{}_{.8}Fe_{0.33}$. Povitskii, V. A.; Granovskii, E. B.; Makarov, E. F.; Malakhov, G. V. (Inst. of Chemical Physics, Moscow). Fiz. Metal. Metalloved.; 38: No. 5, 1095-1098(Nov 1974). (In Russian).

Experimental data from the Moessbauer study lead to the assumption that admixed Fe atoms in the $SmCo_5$ matrix form clusters, with a composition close to $Sm_2(CoFe)_{17}$. The clusters are coherently bound to the matrix. The magnetic moments of the Fe atoms in these clusters form an angle ≈35° with the hexagonal axis c. (JSR)

33967 INFLUENCE OF BORON ON THE PRECIPITATION BY TEMPERING OF TITANIUM AND NIOBIUM CARBIDES IN AUSTENITE STAINLESS STEELS. Henry, G.; Thomas, B.; Tixier, R. Cent. Doc. Siderugique, Circ. Inform. Tech.; 31: No. 1, 53-164(1974). (In French).

The influence of small B additions (<100 ppM) on the structural hardening of austenitic stainless steels, containing C 0.06%, and Ti 0.5% or Nb 0.8%, by quenching and tempering was studied. B accelerated structural hardening and increased the elastic limit following tempering at 750°C for 4 h. Improvement in mechanical properties is associated with modification in the morphology and distribution of TiC and NbC, which precipitate in the grains during tempering. (Metals Abstr.)

33968 STUDY OF THE BREAKDOWN OF A BERYLLIUM BRONZE BY THE INTERNAL-FRICTION METHOD. Mal'tseva, G. K.; Postnikov, V. S. Uch. Zap., Mord. Gos. Univ.; No. 76, 43-48(1972). (In Russian).

L.F. internal-friction phenomena were used to study Cu–1.9% Be bronzes naturally aged for periods of up to 20 years after water

quenching from 800°C. The activation energy for breakdown decreases as the aging period is lengthened, e.g., from 16,000 before aging to 4500 cal/mole after 16 years. The internal-friction measurements were made during isothermal holding in the range 200 to 300°C. (Referativnyi Zh.)

33969 SUPERCONDUCTING PROPERTIES OF Nb_3Sn–COPPER MIXTURES. Hartmann, U. G. Los Angeles; Univ. of Southern California (1974). 161p. University Microfilms Order No. 75-6421.

Thesis (Ph. D.).

There are several current technical applications for conductors and cables fabricated from superconducting materials. Fully dc stabilized conductors with zero voltage current densities in excess of 10^5 A/cm^2 have been developed and are being used in high field solenoids. Projected applications include such diverse areas as magnetically levitated trains, particle accelerators, nuclear fusion research, and electrical power transmission lines. In all cases, interest is due to the economic advantages of reduced power dissipation at high current densities. The superconducting materials with the most promising properties, high H_{c2}, high current densities, and high critical temperatures are intermetallic compounds like Nb_3Sn, V_3Si, V_3Ga, and Nb–Al–Ge. These high T_c, H_{c2} compounds present some difficulty in technical applications, however, because of their extreme brittleness. Due to stability problems, superconductors in high current applications must be used in the form of fine filaments dispersed in a normal metal matrix. This has presented no problems for the ductile alloy superconductors such as NbTi or NbZr, and multi-filamentary cables with over 10^4-5 m diameter filaments have been fabricated from these materials. When the advances of technology allow the fabrication of such cables from Nb_3Sn, V_3Ga, or Nb–Al–Ge, the brittle hardness of these compounds makes small cracks, breaks, and discontinuities in the conductor inevitable. With a sufficiently large number of filaments in the composite conductor, such discontinuities in individual filaments are not necessarily catastrophic, but currently no information exists about the properties of such conductors. It is not known how the stability, critical current, magnetic hysteresis, or ac loss of a composite cable is affected by such breaks, nor even whether the current phenomenological theories are applicable to what is likely to be a randomly connected system. The material configuration investigated in this study, sintered powder mixtures of Nb_3Sn and copper, simulates the random connectivity and range of superconductivity to normal metal ratios that might be expected to exist in such a break. Stability, critical currents, magnetization, and ac losses were determined for a number of samples with varying copper content and found to qualitatively follow the predictions of current theories. The normal conductivity of the mesh or sponge structure formed by the powder mixtures is well explained by a recent heuristic modification to percolation theory and this is expected to describe such filament breaks also. The increase in stability with increasing copper fraction is accounted for by dynamic and steady state stability theories for induced and impressed currents, respectively. Magnetization loops are analyzed in terms of the Bean and Kim critical state models and results are consistent with the stability measurements. Power dissipation in sinusoidally varying fields added to dc bias field is shown to be consistent with the Bean-Hancox theory modified to take into account the increasing field penetration with increasing copper fractions and the resulting eddy current losses. In general, the superconducting properties of these random mixtures are accounted for by the application of existing theories, and the inclusion of copper, although increasing ac losses, is shown to have no drastic effects that would preclude the technological application of multifilament Nb_3Sn cables with occasional broken filaments. (Diss. Abstr. Int., B)

33970 INTERFERENCE CONTRAST FOR EXAMINATION AND PHOTOMICROGRAPHY IN METALLOGRAPHY. Calabra, A. E.; Johns, W. L.; Marts, D. L. (Dow Chemical U. S. A., Golden, CO). pp 1-11 of Microstructural Science. Volume II. Fritzke, G. P.; Richardson, J. H.; McCall, J. L. New York; American Elsevier Publishing Co., Inc. (1974).

Interference contrast for examination and photomicrography is an extremely effective tool for increasing image contrast on metallographically prepared samples. Etching parameters can be less severe, which in turn reduces the chances of forming artifacts and effecting polishing and etching damage. Examples are given for plutonium alloys. (auth)

33971 REPRESENTATION OF THE HIGH-TEMPERATURE TENSILE BEHAVIOR OF THE REANNEALED TYPE 304 STAINLESS STEEL BY THE VOCE EQUATION. Swindeman, R. W. 74-WA/Mat-7. New York; American Society of Mechanical Engineers (1974). 9p. $3.00.

From winter annual meeting of the American Society of Mechanical Engineers; New York, NY (17 Nov 1974).

Tensile tests were performed on a reference heat of type 304 stainless steel (heat 9T2796) in the laboratory reannealed condition. Testing temperatures ranged from 25 to 760°C and strain rates were varied from 1.5×10^{-6} to 8.3×10^{-2}/s. Several models were developed to represent the tensile curves, and each model was restricted to a specific range of applicability. For the inelastic strains below 0.001 a Ludwik-type formulation was developed; it was independent of strain rate but applicable for temperatures up to 760°C. For the strain range 0.001 to 0.05 a second Ludwik-type formulation was developed with minimal strain rate dependence, and the model was restricted to temperatures not exceeding 593°C. For inelastic strains above 0.001 an alternative model was based on the Voce equation. The Voce model was applicable for all temperatures and strain rates and for strains to the uniform strain at the ultimate strength. The ability of the Voce model to represent tensile behavior at strain rates well below those that are practical in the laboratory experimentation was checked by comparing predicted ultimate tensile strength data against creep strength data for minimum creep rates corresponding to the tensile strain rates. The agreement was good. The ability of the Voce model to predict uniform strain behavior was also examined. In the creep range the Voce model overestimated uniform strains for temperatures below 649°C and underestimated them for temperatures above 649°C. (auth)

33972 MANIFESTATION OF HYDRODYNAMIC EFFECT IN THE THERMAL CONDUCTIVITY OF TUNGSTEN. Batdalov, A. B.; Tamarchenko, V. I.; Shalyt, S. S. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 20: No. 6, 171-173(20 Sep 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 20: No. 6, 382-386(20 Sep 1974).

The thermal conductivity of pure single-crystal tungsten was investigated in the interval 2 to 120°K. An anomalous temperature dependence of the thermal conductivity is observed in the temperature region 15 to 40°K, where the normal electron-phonon processes predominate and conditions exist for the establishment of the hydrodynamic transport mechanism. (auth)

33973 EFFECT OF COPPER ON THE PHASE COMPOSITION OF THE ALLOY Ti–9Al–5Zr–2Mo. Volkova, M. A.; Kornilov, I. I.; Nartova, T. T. Izv. Akad. Nauk SSSR, Metal.; No. 1, 223-225 (1975). (In Russian).

A study was made on the Ti–Al–Zr–Mo–Cu system along a cross-section having a content of 16% of (Al + Mo + Zr) and a variable content of copper from zero to 5% by thermal, microstructural and x ray phase analyses and by the change in electrical resistance and hardness. The alloys undergo a conversion in the solid state associated with the breakdown of a β-solid solution and with the formation of α-, α_2-phases and the compound Ti_2Cu. At 600°C the compound Ti_2Cu begins to precipitate at a copper concentration of ~0.8%. The electrical resistance and alloy hardness vary insignificantly as a function of copper concentration and quench temperature. Alloys quenched from 600°C have the lowest values of electrical resistance and hardness. (SJR)

33974 STUDY OF THE Ti–Zr–Nb–Mo SYSTEM ALONG THE Ti–Nb–$ZrMo_2$ CROSS-SECTION. Khegai, I. K.; Budberg, P. B. Izv. Akad. Nauk SSSR, Metal.; No. 1, 226-229(1975). (In Russian).

A study of the system was made at 1200, 1000, 800, and 600°C. Polythermal cuts Ti–$ZrMo_2$ and Nb–$ZrMo_2$ were constructed corresponding to ternary systems in the temperature interval from 600°C to the beginning of alloy melting. The polythermal cuts investigated in this study are not quasibinary, just as the cut Ti–Nb–$ZrMo_2$ is not quasiternary. (SJR)

33975 THERMODYNAMIC PROPERTIES OF LIQUID La–Mg ALLOYS. Afanas'ev, Yu. A.; Bayanov, A. P.; Frolov, Yu. A. Izv. Akad. Nauk SSSR, Metal.; No. 1, 186-190(1975). (In Russian).

By measuring the saturated vapor pressure of magnesium in an inert gas the thermodynamic properties of liquid, La–Mg alloys were investigated in the temperature interval of 1083 to 1133°K, and a range of 10 lanthanum compositions. Calculations were carried out on the activity coefficients of magnesium and lanthanum, partial-molar and integral free energies, enthalpies and entropies of mixing. A negative maximum in the concentration dependence of the change in Gibbs free energy of the La–Mg alloys corresponds with a maximum on the melting diagram at the composition of a singular, congruently-melting compound $LaMg_3$. The shift of the negative maximum in enthalpy and mixing entropy to the side of magnesium indicates the formation of clusters in the alloy rich in magnesium. (SJR)

33976 ULTRASONIC VELOCITY AND COMPRESSIBILITY OF Ga–Cd ALLOYS. Magomedov, A. M. A.; Ismailov, M. A.; Pash-

aev, B. P. Izv. Akad. Nauk SSSR, Metal.; No. 1, 191-193(1975). (In Russian).

Experimental results were obtained on the temperature and concentration dependencies of the ultrasonic velocity a in Ga–Cd alloys containing 10, 30, 50, 60, 70, and 85 wt.% Cd. Calculations were carried out on the temperature coefficients and changes in ultrasonic velocity on going from a solid phase to a liquid phase. The ultrasonic velocity a decreases linearly with increasing temperature up to the melting point. The adiabatic compressibility β_s was calculated from the ultrasonic velocity results, and was compared with the specific resistance of the alloys. The composition-compressibility curve has a negative deviation, while the composition-resistance curve has a positive deviation from the additive line. (SJR)

33977 STUDY OF THE THERMODYNAMIC PROPERTIES OF THE ALLOYS $ErGa_3$ AND $LuGa_3$. Bayanov, A. P.; Soboleva, N. A.; Ganchenko, E. N. Izv. Akad. Nauk SSSR, Metal.; No. 1, 198-200(1975). (In Russian).

By the emf method a study was carried out on the thermodynamic properties of Ga–Er and Ga–Lu alloys at 673 to 875°K in the region of compositions rich in gallium. The change in free energy, enthalpy, and entropy were calculated for the formation of $ErGa_3$ and $LuGa_3$ from a solid rare earth and liquid gallium. The absolute values of the thermodynamic characteristics decrease from erbium to lutetium. (SJR)

33978 PHASE DIAGRAM OF THE NIOBIUM CORNER OF THE Nb–W–Cr SYSTEM. Prokof'ev, D. I. Izv. Akad. Nauk SSSR, Metal.; No. 1, 206-210(1975). (In Russian).

Alloys of the Nb–W–Cr system containing up to 50% of both W and Cr were investigated by microstructural and x ray analyses, and by the change in hardness. Isothermal cross-sections of the system at 1600 and 1000°C were constructed. The phase diagram of the system includes: the single-phase region of the ternary α-solid solution extending from niobium along the Nb–W side, a single-phase region on a base of the intermetallic compound $NbCr_2$, and a wide two-phase region of a mixture of these phases. A decrease in temperature decreases the region of the ternary, α-solid solution. (SJR)

33979 DETERMINING THE SURFACE TENSION OF YTTRIUM ALLOYS BY LEVITATION MELTING. Fogel, A. A.; Sidorova, T. A.; Chuprikov, G. E.; Mezdrogina, M. M. Izv. Akad. Nauk SSSR, Metal.; No. 1, 50-53(1975). (In Russian).

The determination of surface tension is based on the use of the relation existing between the surface tension of the liquid metal and the parameters of the electromagnetic field holding the metal in a suspended state. The form and position of the liquid drop change with a change in field strength. The relation is: $hr = 2\sigma/g\gamma_{liq} = a^2$. Here h is the column height of the liquid metal drop; γ_{liq} is the density of the metal; σ is the surface tension, and r is the radius of curvature of the lower part of the metal drop, while a is the capillary constant. As a result of measuring the surface tension of yttrium alloys by this method it is shown that Tb, Gd, and Fe show surface activity with respect to Y. (SJR)

33980 STRAIN-RATE HISTORY EFFECTS IN POLYCRYSTALLINE MOLYBDENUM AND NIOBIUM. Campbell, J. D.; Briggs, T. L. (Oxford Univ.). J. Less-Common Metals; 40: 235-250 (1975).

Specimens of annealed polycrystalline molybdenum and niobium have been strained in compression at temperatures of 200, 250 and 292°K, the strain rate being suddenly increased during plastic flow at a strain of about 8%. The initial strain rate was varied between 1.7×10^{-4} and 0.5 s^{-1} and the strain-rate ratio was varied between 3 and 6×10^5, the maximum strain rate being about 100 s^{-1}. In each test the applied stress and the incremental stress caused by the strain-rate change were recorded as functions of time. The results are compared with those of earlier tests conducted at constant strain rates, and it is shown that for both materials the flow stress is dependent on strain-rate history. An approximate analysis is made of the heat loss during deformation at constant strain rate, so that corrections can be made for the temperature rises caused by plastic work. After making these corrections, it is found that significant differences (up to an order of magnitude) exist between the strain rates obtained at a given stress level, depending on the previous strain history. These differences vary in a complex manner with the initial and final strain rates, and it seems possible that a change in the rate-controlling process occurs between the low and high rates in the range covered. (auth)

33981 RARE-EARTH METALS AND THEIR ALLOYS. Kraposhin, V. S.; Linetskii, Ya. L. Itogi Nauki Tekh., Metalloved. Term. Obrab.; No. 6, 84-140(1972). (In Russian).

Recent developments in the study of rare-earth elements and their alloys are summarized. Attention is paid to the atomic and electron structure of these elements as governed by their peculiar position in the Periodic Table. The energy characteristics exhibited by these structures are interpreted in terms of the pressure/temperature phase diagrams and the mutual solubility of the constituents of binary solid solutions formed by pairs of rare-earth metals. Alloys of rare-earth metals with other transition elements are discussed, their phase diagrams are analyzed and correlated with x-ray diffraction data and mechanical and physical properties. Of particular interest are the magnetic properties of rare-earth elements and alloys, which may show either ferro-magnetic or antiferro-magnetic ordering. (Metals Abstr.)

33982 MONOCRYSTALLINE TUNGSTEN APPLICATION IN ATOMIC BEAM DETECTORS. Savitskii, E. M.; Abashev, Yu. G.; Burkhanov, G. S.; Raskatov, N. N.; Chernyshev, I. V. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 218: No. 3, 567-569(21 Sep 1974). (In Russian).

The possibility of using W monocrystals as ion emitters for the detection of atomic or molecular beams in quantum frequency measurements was studied. The background emission of monocrystals and polycrystals of W was compared in the temperature range from 1100 to 2200°K. The emission consisted primarily of K^+ and Na^+ contained in the emitter material. The most intense and frequent bursts were observed between 1100 and 1500°K. The polycrystalline emission was unstable, but the emission of the monocrystals was stable throughout the temperature range studied. W monocrystals can be used as emitters in atomic beam detectors, in ion sources of mass spectrometers, and in all cases where the bursts of ion current of impurities cause undesirable effects. (JSR)

33983 (SAND-75-6005) STUDY OF PHASE TRANSFORMATIONS IN TITANIUM ALLOYS. II. Contribution to the Study of Transformations in the Titanium Alloy $TA_6V_6E_2$ Under Isothermal Conditions After Hardening From the ($\alpha + \beta$) Field. Fontalirand, C.; Beauvais, C.; Fidelle, J. P.; Hocheid, B. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 – Montrouge (France)). Mar 1975. Translation of CEA-R-4566. 97p. Dep. NTIS $8.00.

Results of studies are presented on isothermal transformations in Ti-base–V–Al–Sn alloys after dissolution in the $\alpha + \beta$ field. Results show that in the 800 to 650°C range quantities of α martensite are formed. The γ phase is stable above 750°C and disappears rapidly as the temperature drops. In alloys TA_6V and $TA_5V_6E_2$, an isothermal decomposition of the α' martensite just below the M_S temperature is found. The ω phase is formed during an isothermal hold between 500°C and 300°C by short-range diffusion. (auth)

33984 EFFECTS OF THERMAL MAGNETIZATION AND RESTORATION OF COERCIVE FORCE OF HEATED $SmCo_5$ MAGNETS. Livshits, B. G.; Lileev, A. S.; Menushenkov, V. P. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 11, 140-141(1974). (In Russian).

A study was made of the effect of low-temperature annealings in a magnetic field at temperatures of 100 to 500°C on the magnetic properties of heated magnets made of $SmCo_5$. Magnetic annealing at 300 to 400°C leads to an increase in coercive force by 10 to 15%. It is shown that on heating a sample to 650 and 700°C with holding at this temperature for 1 minute leads to a sharp fall in coercive force. Subsequent heating in a magnetic field at a temperature of 400°C for 5 min leads to complete or partial restoration of coercive force. It was found that heating samples which were preliminary demagnetized partially or completely by the application of a reverse field leads to an increase of the induction of these samples. For example, a sample, completely demagnetized by a reverse field ($4\pi I = 0$), after heating without application of an external field to 450°C had at room temperature an induction of 8000 G in a closed magnetic circuit, that is, it almost reached the value of the maximum residual induction (8550 G). The effects of "thermal magnetization" and restoration of coercive force, it is proposed, are associated with phenomena of strengthening the domain wall at crystal structure defects. (tr-SJR)

33985 STRUCTURE OF IRON ALLOYED WITH VANADIUM. Zhukov, A. A.; Novokhatskii, V. A.; Epshtein, L. Z.; Ul'yanova, B. Ya. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 11, 162-164 (1974). (In Russian).

A study was carried out on cupola iron alloyed in a ladle with vanadium by means of an exothermic alloying mixture. Alloying iron with 2.38% V resulted in an almost two-fold increase in tensile strength. The structure of the metallic matrix became perlitic. It was strengthened with vanadium carbides. Electron-microscopic studies showed that besides the primary vanadium carbides, secondary or eutectoid carbides were observed in the structure of the alloyed iron. It is shown that the iron contains complex inclusions consisting of three phases which cocrystallize during the eutectic conversion: cementite, austenite, and vana-

dium carbide. It is shown that under industrial conditions it is possible to obtain partially graphitized iron even at a relatively high content of vanadium. (tr-SJR)

33986 ORIGIN OF FERROMAGNETISM AND ANTIFERROMAGNETISM IN ALLOYS OF TRANSITION METALS. I. Alloys of the First-Row Transition Metals With the Monovalent Noble Metals. Vogt, E. (Univ., Marburg, Ger.). Phys. Status Solidi (a); 28: No. 1, 11-38(16 Mar 1975).

Among the numerous metallic elements and their innumerable possibilities of alloying, ferromagnetic or antiferromagnetic behavior is a rare phenomenon. Such cases are collected to analyze the conditions for the occurrence of ferro- or antiferromagnetic coupling. For this problem, no simple and uniform answer is possible since most different theoretical models are used to describe the magnetic properties of metals and alloys, especially the model of localized atomic moments and the opposite model of the collective electron theory. For this reason, the inconvenient empirical way is necessary to treat this extensive and complicated matter. Transition metal (T-metal) alloys with copper, silver, and gold are considered using a model of local moments. Ferro- or antiferromagnetism in alloys containing only T-metals are described, based on the itinerant electron model. Further cases of weak or nearly attained ferromagnetism in intermetallic phases of T-metals with non-transition-elements and examples for the influence of atomic ordering on the origin of ferro- or antiferromagnetic behavior are also discussed. (auth)

33987 THERMAL DECOMPOSITION OF $SmCo_{5+x}$. Khan, Y.; Qureshi, A. H. (Ruhr-Univ., Bochum, Ger.). Phys. Status Solidi (a); 28: No. 1, 169-174(16 Mar 1975).

Sm–Co alloys close to the composition $SmCo_5$ were investigated by metallographic, thermomagnetic, and x-ray diffraction methods. The effect due to evaporation losses of Sm on the equilibrium state of the Sm–Co alloys was studied. The results obtained do not support the suggestion of many workers for a unique stability of the $SmCo_5$ phase. The role of coherency strains in the thermal stability of the phase $SmCo_{5+x}$ is discussed. (auth)

33988 NEUTRON-DIFFRACTION INVESTIGATION OF UGa_2. Sechovsky, V.; Smetana, Z.; Menovsky, A. (Charles Univ., Prague). Phys. Status Solidi (a); 28: No. 1, K37-K40(16 Mar 1975).

The neutron diffraction patterns of powdered UGa_2 were made at 4.2 and 300°K. Results are used as a basis for suggesting that the magnetic structure of UGa_2 is collinear and generally monoclinic. Data on calculated and observed nuclear and magnetic intensities at 4.2 and 300°K are tabulated. (JRD)

33989 ELECTRON MOBILITY IN Cd_3As_2 AT 4.2°K. Cisowski, J.; Bodnar, J. (Dept. of Solid State Physics, Zabrze, Poland). Phys. Status Solidi (a); 28: No. 1, K49-K51(16 Mar 1975).

An interpretation of electron mobility at 4.2°K in this compound on the basis of transport theory is presented. The value for the static dielectric constant $\epsilon_0 = 42$ provides a good fit of the experimental data to the theoretical curve. Results are presented in plots showing concentration dependence of the electron effective mass in Cd_3As_2 at low temperatures. (JRD)

33990 GROWTH KINETICS OF NbC PARTICLES IN 20Cr–25Ni AUSTENITIC STEELS. Adamson, J. P.; Martin, J. W. (Oxford Univ.). Metallography; 8: No. 2, 169-176(Apr 1975).

Four steels of differing Nb/C ratio have been solution-treated then aged directly for periods up to 10^7 s at temperatures between 650 and 1100°C. Parabolic growth of the intragranular NbC particles was observed, and from the measured particle sizes, the time to form a particle of diameter 1000Å was calculated for each alloy and aging temperature. The results are compared with calculated growth curves using an equation employing the invariant field approximation to simplify the analysis of the diffusion problem. Although the Nb diffusion data necessarily employed relate to a pure γ-iron matrix, the correlation with experimental results appears adequate to encourage the further use of the analysis. (auth)

Radiation Effects

Refer also to abstracts 34870, 35164, and 35208.

33991 (AERE-TP-590) NUCLEATION AND EARLY GROWTH OF INTERSTITIAL DISLOCATION LOOPS IN IRRADIATED MATERIALS. Hayns, M. R. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). [1973]. 26p. Dep. NTIS (US Sales Only) $4.00.

A hierarchy of rate equations is solved to describe the homogeneous nucleation of interstitial dislocation loops in irradiated materials. Calculations for graphite and M316 stainless steel have been performed. The concept of nucleation time is examined and a procedure is adopted which gives a useful criterion for defining the end of the nucleation period. Calculations have been performed which demonstrate the effects of temperature, dose rate, and network dislocation density on the nucleation and final concentration of interstitial loops. The assumption that di-interstitial atom pairs are stable against thermal dissociation is examined and found to be appropriate for these conditions. (auth)

33992 (BNL-50434) COMPUTATIONAL METHOD FOR THE EVALUATION OF RADIATION EFFECTS PRODUCED BY CTR-RELATED NEUTRON SPECTRA. Parkin, D. M.; Goland, A. N. (Brookhaven National Lab., Upton, N. Y. (USA)). Sep 1974. Contract AT(30-1)-16. 41p. Dep. NTIS $4.00.

A computational method is described which can be helpful in providing an understanding of the relationship between irradiation effects produced by CTR simulation neutron spectra and by actual CTR spectra. This method is capable of comparing fission-neutron and CTR neutron sources as well as spallation neutron sources (e.g., BLIP and LAMPF), and deuteron breakup sources. The required nuclear data are obtained from the ENDF/B-III data files. Three important quantities are evaluated for each incident neutron spectrum: the normalized primary recoil energy spectrum P(T), the spectrum-averaged "generalized parameter" cross section, G(E), and the spectrum-averaged reaction cross sections, e.g., $\langle\sigma_{n,\alpha}\rangle$. G(E) typically takes the form of the damage energy cross section, but it can take other forms. Results are presented for a variety of neutron spectra incident upon Nb, V, Al, Ti and C. A number of conclusions are presented at the end of the report, including the observation that deuteron-breakup sources can simulate overall first-wall radiation effects more closely than other simulation sources can. (auth)

33993 (CONF-740997-1) CRITICAL CURRENT CHANGES IN LOW TEMPERATURE FAST NEUTRON IRRADIATED NIOBIUM. Brown, B. S. (Argonne National Lab., Ill. (USA)). 1974. 7p. Dep. NTIS $4.00.

From international meeting on flux pinning in superconductors; Sonnenberg, F. R. Germany (23 Sep 1974).

The samples were single crystal niobium rods, outgassed at 2170°C for 22 hours at a final vacuum of 4×10^{-10} Torr, and were irradiated at 6 K ± 1 K in a fast neutron flux of 1×10^{12} n/cm²-sec (E > 0.1 MeV). Both magnetization and ac loss measurements were made in situ at 4.6 K with the reactor shut down. Low temperature fast neutron irradiation leads to an increase in the amount of trapped flux at H = 0 (magnetic remanence) and the upper critical field H_{c2}. H_{c2} exhibits a slightly less than linear increase with dose as is expected from the relationship between H_{c2} and the normal state resistivity and the radiation annealing theory of defect production. The critical current increases rapidly for small doses, while at higher doses, the critical current decreases at low applied field and increases at high fields. (PMA)

33994 (FZK-162) INVESTIGATION OF THE EFFECTS OF RADIATION AND CRYOTEMPERATURE ON ENGINEERING MATERIALS. Bradford, E. W. (General Dynamics/Fort Worth, Tex. (USA)). 31 May 1963. 102p. Dep. NTIS $8.25.

Prepared for Aerojet-General Corp., Azusa, CA.

Selected metal and nonmetal structural materials were tested at General Dynamics/Fort Worth in a combined radiation and cryotemperature environment. The specimens were irradiated and tested while immersed in liquid hydrogen. Infrared spectra from the nonmetal materials and elongation and area-reduction measurements on the metals were obtained in addition to the tensile data. The only statistically significant change that occurred was in the elongation of smooth titanium specimens, which showed an average decrease of 31%. (auth)

33995 (FZK-310-2) NERVA IRRADIATION PROGRAM. Volume II. GTR Test 18-Materials Test. McMillan, W. D. General Dynamics/Fort Worth, Tex. (USA)). 1 Dec 1967. 27p. Dep. NTIS $14.50.

GTR Test 18 is a continuation of a series of irradiation tests designed to determine the effects of nuclear radiation, in combination with other environmental factors, on materials and components proposed for application in the NERVA engine. In this test, tensile specimens of Inconel 718, Inconel 625, Hastelloy X, and Stainless Steel 347 were irradiated at ambient temperatures to three levels of radiation exposure. After irradiation, the specimens were pulled at temperatures ranging from 780 to 1540°F to determine the effect of radiation on boron-containing materials. In addition to this test, tensile and flexure specimens of beryllium 2099 and 4055 were irradiated in liquid nitrogen to a neutron fluence of 8.4×10^{16} n/cm² (E > 2.9 MeV), then tested at LN_2 temperature (with and without warmup) and at room temperature. Some specimens were returned to Westinghouse Astronuclear Laboratory for testing. Bearing cage materials were also irra-

diated in liquid hydrogen to a gamma dose of 5×10^{10} ergs/g(C) and a fast-neutron fluence of 1×10^{16} n/cm^2. These materials were returned to Aerojet-General Corporation for testing. Results are discussed in detail. (auth)

33996 (FZK-342-1) NERVA MATERIALS IRRADIATION PROGRAM. GTR Test 19. Volume I. Test Description and Summary of Results. Smith, E. T. (General Dynamics/Fort Worth, Tex. (USA)). 1 Apr 1968. 240p. Dep. NTIS $15.00.

The experiment described was designed to determine the effects of nuclear radiation in combination with cryogen (either liquid hydrogen or liquid nitrogen) and various other environments on the mechanical and metallurgical properties of metals and alloys scheduled for use in NERVA systems and components. Tensile specimens of Al-base alloys Ti-base alloys stainless steel 347, Inconel 625, Inconel 718, Inconel X-750, Hastelloy X, Hastelloy C, A-286, Monel, Udimet-630 and Waspaloy were irradiated in GTR in LH_2, LN_2, or 590°R water. A summary of all data and a discussion of the tests and test results are given. (JRD)

33997 (FZK-342-3) NERVA MATERIALS IRRADIATION PROGRAM. GTR Test 19. Volume III. Fractography and Metallography. Wolanski, Z. R.; Ghena, P. F.; Smith, E. T. (General Dynamics/Fort Worth, Tex. (USA)). 15 May 1968. 356p. Dep. NTIS $21.00.

Results of experiments are reported conducted to determine the effects of nuclear radiation in combination with cryogen (either liquid hydrogen or liquid nitrogen) and various other environments on the mechanical and metallurgical properties of metals and alloys scheduled for use in NERVA (Nuclear Engine for Rocket Vehicle Applications) systems and components. Tensile specimens were irradiated in the Ground Test Reactor (GTR) in an ambient-air environment or while submerged in LH_2, LN_2, or 590°R water. Postirradiation mechanical-property tests were then performed on the specimens under various environmental conditions. Changes in the fracture mode and/or microstructure were small to undetectable on 7075-T73 Al alloy and H-Monel alloy. A-286 and stainless steel 347 exhibited a fracture mode transition between LH_2 and LN_2 temperatures. The LH_2 to LN_2 transitions were from brittle to ductile for A-286 and from ductile to brittle for stainless steel 347. Titanium 5Al-2.5Sn ELI showed cleavage along crystallographic planes within the matrix of dimples (MVC), and indications are that irradiation decreases the notched fracture characteristics of this alloy. Changes observed in tensile properties of Inconel 625 were due to radiation hardening. The intergranular failure mode along a path of dimple rupture was due, primarily, to the intermetallics lying on the grain boundaries. Hastelloy X showed elongation differences between the LH_2 and LN_2 tests, with the LN_2 tests showing higher elongation. High concentrations of carbides formed localized high-stress-rupture points in combination with dislocations in this alloy. The weld specimen was more brittle, showing a cleavage mode of failure. The Waspaloy control-specimen tensile failure was due to a high triaxial stress just below the surface at a TiN or (Ti,C)N deposit. This deposit fractured and carried the failure into the parent metal. Some increase in carbides was noted in the irradiated Waspaloy specimen which could have been due to segregation. The trend of LH_2 test results for Inconel 718 is comparable to that indicated for Hastelloy X. Welding techniques apparently had a greater effect than radiation on the mechanical properties of the weld specimens, however. The Udimet 630 alloy was the exception to all others analyzed. There was a transformation of microconstituents from the fcc to the orthorhombic Ni_3Cb phase which was drastic enough to be seen by electron fractography and by optical and electron metallography. This complex transformation process involved the alloy chemistry, test temperature, irradiation, strain, and a pulse energy (tensile failure shock). (auth)

33998 (JAERI-M-5567, pp 1-10) RADIATION DAMAGE STUDIES OF REACTOR MATERIALS BY USING HEAVY-ION ACCELERATORS. Ishino, S. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on heavy energy research with heavy ions.

The use of accelerators in radiation damage studies is reviewed historically, and the significance of the use of heavy-ion irradiation in various aspects of radiation effects studies is pointed out. Major problems to be overcome in the critical materials of fast breeder and controlled thermonuclear reactors are summarized and a discussion is made of how these problems are solved by the use of heavy-ion accelerators. Merits and demerits of heavy-ion irradiation are summarized from the standpoint of simulation of irradiation with fast neutrons. (JA)

33999 (JAERI-M-5567, pp 11-14) HEAVY ION IRRADIATION DAMAGE IN METALS. Shiraishi, K. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Experimental investigations with heavy-ion irradiation are useful for evaluation of irradiation damage in fusion reactor materials. Ion energies required for the investigation are discussed based on LSS theory and energy-range relationships. Well-controlled ion energy in the range from 10 to 300 keV is demanded for the study on surface phenomenon (sputtering), while an energy of about 100 MeV is favorable for simulation for fast neutron irradiation damage in the materials. (JA)

34000 (JAERI-M-5567, pp 15-21) SIMULATION STUDY OF VOID SWELLING IN REACTOR MATERIALS BY LOW-ENERGY ION IRRADIATION. Terasawa, M. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

The volume change of reactor materials caused by fast neutron irradiation is recognized to be an important matter for reactor design. There is a possibility of obtaining easily and in short time the material state irradiated up to high neutron fluence using accelerated heavy ions. A simulation technique was developed for fast neutron irradiation effects by a 200-keV accelerator. Austenitic stainless steels, SUS304, SUS316, and AISI321 are examined. To take into account the helium atoms produced as a result of the (n,α) reaction, helium ions are implanted prior to heavy ion irradiation at elevated temperature. C^+ ions were used as heavy ions. Irradiated samples were observed by transmission electron microscope. By bombardment with 200-keV C^+ ions the dependence of void formation on irradiation temperature was studied from 400°C to 700°C. The irradiation dose dependence was also studied at 625°C. It was found that the temperature dependence shifted about 150°C higher as compared with fast neutron irradiation. The dose dependence showed similar behavior to reactor data if preinjected helium dose was controlled properly. The possibility of quantitative estimation of swelling by low-energy ion bombardment was also shown. (JA)

34001 (RD/B/N-2025) EXAMINATION OF METALLIC SPECIMENS EXPOSED IN FUEL ELEMENT ASSEMBLIES OF THE DRAGON REACTOR. Pearce, R. J.; Thomas, R. J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jun 1971. 31p. (RPC/CM/P-(71)37). Dep. NTIS (US Sales Only) $4.75.

Specimens manufactured from various alloys have been exposed to the Dragon reactor coolant at temperatures above ~750°C for periods of either 256 or 493 days. The only reactions observed on these specimens have oxidation and possible decarburization. When oxidation occurred this took the form of both intergranular attack and surface layer formation. Comparing the metallographic data obtained with weight gain data from other sources suggest that the order of reactivity of some alloys may be reversed when considering the high purity Dragon atmosphere in relation to normally lower purity test gas atmospheres. Evidence of carbon or fission product deposition has not been obtained. (auth)

34002 (TID/SNA-976) NERVA COMPONENTS IRRADIATION PROGRAM. Volume V. ASTR Tests 4, 4A, and 5. Guinn, J. W.; Pou, C. G.; Wachowski, J. S. (General Dynamics/Fort Worth, Tex. (USA)). 11 Feb 1965. AF 29(601)-6213. 231p. Dep. NTIS $14.75.

Several mechanical components proposed for use in the NERVA engine were subjected to radiation from the Aerospace Systems Test Reactor (ASTR). They consisted of bearings to be used in a turbine pump assembly (TPA). The bearings were installed in testers and three tests were run. Each test was scheduled for 60 minutes duration. The bearings were dynamically operated at 24,000 rpm with liquid hydrogen flowing through the tester and the reactor power at 10 Mw. Results of the tests are given. (auth)

34003 (TID/SNA-1307) HIGH TEMPERATURE RADIATION EMBRITTLEMENT OF HASTELLOY X: INCONEL 625, AND AISI 347. Dixon, C. E.; Funk, C. W.; Weleff, W. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1967. 25p. Dep. NTIS $4.25.

The useful service limitations of three solutioned-hardened alloys which are candidates for nuclear rocket nozzle materials needed to be established to determine their suitability for the NERVA system. The nozzle environment includes thermal neutron exposures between 10^{17} and 10^{19} nvt and operating temperatures as high as 1600°F. The alloys, Hastelloy X, Inconel 625, and AISI 347 with low boron contents, were exposed to 6×10^{17}, 40×10^{17} and 100×10^{17} nvt (thermal) at ambient reactor temperatures and tensile tested at low strain rates at temperatures between 750°F and 1540°F. Exposure and temperature thresholds, for elongation

decreases, as low as 6×10^{17} nvt and 1040°F were observed. AISI 347 had slightly higher thresholds than Hastelloy X or Inconel 625. The ductility decreases were largest at the maximum temperature of 1590°F and maximum exposure of 10^{19} nvt. Elongation decreases of 51%, 57%, and 42% were observed for these conditions for Hastelloy X, Inconel 625, and AISI 347 respectively; however, the final elongation still remained satisfactory: Hastelloy X–21%, Inconel 625–18%, and AISI 347–35%. (auth)

34004 (TID/SNA-1339) RADIATION EFFECTS ON SHEAR STRENGTH OF SEVERAL ALLOYS IN A LIQUID HYDROGEN ENVIRONMENT. Weleff, W. (Aerojet-General Corp., Sacramento, Calif. (USA)). 13 Jun 1966. 26p. Dep. NTIS $4.50.

A study was conducted to determine the effect of nuclear radiation on shear strength of selected materials while at liquid hydrogen (LH_2) temperature. The materials selected are considered for use in structural applications for NERVA and other nuclear propulsion systems. Ten alloys representing four different groups of materials (aluminum, titanium, stainless steels, and nickel base alloys) were tested in double shear after irradiation for 200 hours in liquid hydrogen, to an integrated dose level of 5.6×10^{16} nvt; (E > 1.0 MeV), while submerged in hydrogen and without intermediate warm up. The results of these tests and comments pertaining to the radiation effects on double shear are reported. (auth)

34005 (TID/SNA-1561) RADIATION EFFECTS ON MATERIALS AT LIQUID HYDROGEN TEMPERATURE. Dixon, C. E.; Weleff, W.; Funk, C. W. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 20p. Dep. NTIS $4.00.

Eleven commercial aluminum, austenitic nickel and iron base alloys were irradiated at –420°F to an integrated dose of 5×10^{16} neutrons/cm^2 (E > 1.0 MeV). Post irradiation tensile and shear properties were measured at –420°F prior to warm up. Most alloys showed significant increases in yield strength. A smaller number of the alloys showed ultimate strength increases and some showed sufficient ductility loss to preclude their use as a structural material in this cryogenic radiation environment. Shear strengths and notched tensile strengths were relatively insensitive to this level of irradiation. (auth)

34006 (WANL-TMI-912) ANALYSIS OF ORALLOY WIRE ACTIVATIONS IN PAX. Diamond, D. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 31 Dec 1963. 4p. Dep. NTIS $4.00.

Results of studies conducted to determine the correct method of extrapolating activation curves for Oralloy wires used in the PAX critical assembly experiment are summarized. It was found that a linear extrapolation can be used to determine the activation rate at zero radius. (JRD)

34007 EMBRITTLEMENT OF AUSTENITIC STAINLESS STEELS IRRADIATED WITH ALPHA-PARTICLES. Matsumoto, K.; Kataoka, T. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)); Kamei, H.; Terasawa, M.; Karasawa, T. Trans. Iron Steel Inst. Jap.; 14: No. 2, 118-121(Mar 1974).

Alpha particles accelerated by a cyclotron were directly injected into thin specimens of 304 and 316 austenitic stainless steels, and the relation between the embrittlement of the specimens at a high temperature and helium dosage was examined. In the range of helium atom fraction from 9×10^{-7} to 3.1×10^{-5} and of testing temperature from 600° to 800°C, the total elongation, ϵ, for both kinds of materials was empirically given as $\epsilon = -A \log n + B$ where n is helium atom fraction. Further, the relation between A and testing temperature was related in the Arrhenius form, indicating that the embrittlement may be governed by a thermal activation process, whereas, B was unrelated to the helium atom fraction. Helium bubbles, which migrated to grain boundaries during straining, appeared to enhance the development of premature intergranular cracks. (auth)

34008 RESULTS FROM AN ANALYTICAL MODEL FOR SECONDARY ELECTRON EMISSION YIELD AND COMPARISON WITH EXPERIMENTAL VALUES FOR Au AND Al. Richard, C.; Bindi, R.; Lanteri, H.; Keller, P. (Laboratoire de Physique Experimentale, Nice). Thin Solid Films; 26: No. 1, 119-127 (Mar 1975). (In French).

Conditions for comparison between experimental data and the theoretical results obtained from Amelio's analytical model of secondary electron emission are defined. The quantity numerically comparable is the yield δ_s due to the contribution to secondary electron formation by the primary electrons during their penetration into the target. The model presented leads to a choice of the mean free path which is unrealistic and inconsistent with the theory in terms of the Boltzmann transport equation. (auth)

34009 IRRADIATION DAMAGE IN A Al–2.2 Mg ALLOY. King, R. T. (Oak Ridge National Lab., TN); Jostsons, A. Met. Trans.; 6A: No. 4, 863-868(Apr 1975).

The effects of neutron irradiation below 3.6×10^{22} neutrons/cm^2 (>0.1 MeV) and 5.8×10^{22} neutrons/cm^2 (thermal, <0.414 eV) on the microstructure and creep-rupture properties at 50°C of the 5052 aluminum alloy were determined. Irradiation-induced strengthening is attributed to the formation of $\beta' Mg_2Si$ precipitate and dislocation loops. Total creep-rupture elongations before irradiation were over 25 pct, while irradiated specimens strained only about 1 pct. The loss of ductility was accompanied by a propensity for intergranular fracture. (auth)

34010 BOMBARDMENT INDUCED SURFACE DAMAGE IN A NICKEL SINGLE CRYSTAL OBSERVED BY ION SCATTERING AND LEED. Heiland, W.; Taglauer, E. (EURATOM, Garching, Ger.). pp 117-122 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F.R. Germany (24 Sep 1972). See CONF-7209125-.

In an experiment which combines ion scattering at low energies and low energy electron diffraction (LEED), the influence of Ar^+ ion bombardment on the structure of a Ni(110) single crystal surface is investigated. At an energy of 1 keV, Ar^+ ion scattering from an undisturbed single crystal face is governed by multiple scattering which can be described by sequences of binary collisions. Computer simulations of the scattering process show that by introducing surface defects changes in the backscattering spectra occur. The surface damage from the ion beam gives indeed rise to increasing binary scattering, thereby decreasing multiple scattering. These changes are observable above 10^{15} ions/cm^2. Results suggest the production of point defects and extended defect structure. This is in qualitative agreement with the measurement of the widths of LEED spots, where the widths increase and become asymmetric with increasing dose. The production of point defects reaches saturation at 10^{16} ions/cm^2, at the dose rate applied. (auth)

34011 NECESSARY CONDITION FOR THE APPEARANCE OF DAMAGE-INDUCED SURFACE-TOPOGRAPHY DURING PARTICLE BOMBARDMENT. Hermanne, N. (Libre Univ., Brussels). pp 207-215 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F.R. Germany (24 Sep 1972). See CONF-7209125-.

A first approach to the establishment of an "order-of-magnitude" criterion for the initiation of damage-induced surface topography on clean and well-polished metal single crystals is proposed. It is based on a model proposing a mechanism of preferential erosion of parts from the sample surface due to a local increase of sputtering yield above "extensive defects." These "extensive defects," resulting of the migration of the point defects, created during the collision cascade started by the incoming ions, can indeed influence the sputtering yield if they are located close under the surface, i.e., when the surface has regressed, due to sputtering, to the level where these "extensive defects" have been formed. The condition implies that the formation of "extensive defects" must have taken place before the surface reaches them. The condition is written in terms of the irradiation parameters and quantities characteristic for the migration of point defects due to the presence of a potential gradient related to the "extensive defects" under formation. (auth)

34012 SURFACE DAMAGE AND TOPOGRAPHY OF ERBIUM METAL FILMS IMPLANTED WITH HELIUM TO HIGH FLUENCES. Blewer, R. S. (Sandia Labs., Albuquerque, NM). pp 227-232 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F.R. Germany (24 Sep 1972). See CONF-7209125-.

Topographical and expansion effects which occur as a result of implanting erbium thin films with helium up to fluences of 1.5×10^{18} He^+/cm^2 are described. There exists an inverse relationship between critical dose and annealing temperature with respect to the formation of surface bubbles. Post implantation annealing at or below 400°C is found to strongly reduce implantation induced expansion for doses less than 3.5×10^{17} He^+/cm^2, but is observed to result in increased expansion above this dose. At temperatures above 400°C, expansion is increased for all doses investigated. Details of bubble development in the implanted layer are discussed and the manner in which surface bubbles develop from enlarged subsurface bubbles is illustrated. (auth)

34013 BLISTERING OF POLYCRYSTALLINE AND MONOCRYSTALLINE NIOBIUM. Kaminsky, M.; Das, S. K. (Argonne

National Lab., IL). pp 233-238 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

Radiation blistering of niobium surfaces was investigated for normally incident He^+ and D^+ projectiles. For the He^+, the bombarding energies were 0.5 and 1.5 MeV, the targets were both monocrystalline and polycrystalline niobium at room temperature and at 900°C, and the total dose was from 0.01 to 1.0 C/cm^2. For cold-worked samples at room temperature, 0.5-MeV He^+ ions produced large blisters (up to 500 μm in diameter), many of which were ruptured; 1.5-MeV He^+ ion implantation produced one big blister covering most of the irradiated area. For the D^+ ion implantation, the bombarding energies were 0.250 and 0.5 MeV and the targets were all polycrystalline. Implanting 0.250-MeV D^+ ions in annealed polycrystalline Nb at 700°C produced small blisters for doses ranging from 1.6 to 3.0 c/cm^2. Preliminary results on the skin thicknesses of ruptured blisters indicate a close relationship between the thickness and both the projected range of the ions and the peak in the defect distributions. (auth)

34014 BLISTERING OF MOLYBDENUM UNDER HELIUM ION BOMBARDMENT. Erents, S. K.; McCracken, G. M. (Atomic Energy Authority Research Group, Abingdon, Eng.). pp 239-246 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F.R. Germany (24 Sep 1972). See CONF-7209125-.

Polished molybdenum targets have been bombarded with helium ions of energy from 7 to 80 keV in ultra-high vacuum. During bombardment, the release of gas was continuously monitored and after bombardment the targets were examined in a scanning electron microscope. Blister formation was observed to occur after a critical dose of ~5×10^{17} ions/cm^2, and the appearance of blisters coincides with gas release from the surface. The average size of the blisters increases with energy but not with ion dose. In addition to room temperature observations, blisters have also been examined following high temperature bombardment of molybdenum, and room temperature bombardments of W, Pt, Ni, Cu, and Zr targets. (8 fig.) (auth)

34015 SECONDARY EMISSION OF CONDUCTORS ON BOMBARDMENT BY POSITIVE IONS. I. Fast Ions. Pavlov, V. I.; Starodubtsev, S. V. pp 5-23 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

The emission of knock-out electrons and the reflection of positive ions was investigated on various metal and oxide targets. Surface-adsorbed gases in most cases increase the knock-out effect, while oxidation of the surface material conversely decreases the effect. The target temperature as an independent factor has no noticeable effect on the emission of δ-rays and the reflection of positive ions. The electron work function is very sensitive to the condition of the surface. The metals Pt, Cu, Te, Sn, Al, and Zn show a decreasing coefficient for knock-out electrons, and also a decreasing work function. The maximum energy of the secondary particles (10 V) is small compared with the energy of the primary ions (1000 V). Measurements of the coefficient for knock-out electrons gave values many times smaller for oxides than for pure metals. (SJR)

34016 SECONDARY EMISSION OF CONDUCTORS ON BOMBARDMENT BY POSITIVE IONS. II. Slow Ions. Pavlov, V. I.; Starodubtsev, S. V. pp 23-29 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

An experimental arrangement is described in which positive ions from a heated metal spiral covered with KCl or NaCl are directed by an electric field onto a target material. Sensitive galvanometers measure the ion current in the target and also the secondary electron emission of the target. The energy of the bombarding ions is accurately determined. Thus it is possible to measure the secondary electron emission even for very slow ions, for example, those having energies of 5 to 10 volts. Along with the electron knockout coefficient γ it is also possible to determine directly the work function ϕ, and thus to determine the relation between these two quantities. Tungsten is the most efficient with respect to releasing electrons by ion collisions with a noticeable knockout of electrons ($\gamma = 0.005\%$) beginning at a bombarding energy of 10 V and rising to $\gamma = 0.33\%$ at an ion energy of 70 V. For molybdenum a noticeable emission begins at a higher ion energy (12 V) with a γ value of 0.24% at an ion energy of 70 V. Platinum shows lower values of the electron knockout coefficient γ. The electron knockout coefficient was found to be related to the work function ϕ as follows: $\gamma = Be^{-c\phi}$. Here B and c are constants. (SJR)

34017 FORMATION OF POSITIVE IONS ON BOMBARDING TUNGSTEN WITH MOLECULES OF ALKALI HALIDE METAL SALTS. Starodubtsev, S. V. pp 29-45 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

Processes taking place during formation of alkali metal positive ions on tungsten wire were investigated experimentally to explain the mechanism of ion emission. The ion and electron currents from tungsten wire coated with NaCl, KCl, CsCl, and RbCl were measured. Salt molecules from a furnace also impinged on the W-wire to give a current of positive ions. The ion current from the wire was 10^{-7} a. For all the salts at T < 1300°K, the ion current decreases with decreasing temperature of the wire. On the other hand, for most salts at T > 1300°K an increase in ion current is observed with a decrease in wire temperature. The exception is NaCl that shows a continuous increase in ion current on increasing the temperature from 1200 to 2400°K. The ratio of the ion current to the current at T = 2400°K is plotted as a function of wire temperature. The log of the ion current during ionization of Na vapors on tungsten is a linear function of the reciprocal temperature. The sharp fall in ion current at T < 1300°K is associated with a change in surface conditions on W because of deposited salt molecules. The ion current for CsCl and RbCl is established rapidly. Absolute ionization coefficients were determined for NaCl, KCl, CsCl, and RbCl at 1600, 2000, 2400, and 2500°K. (SJR)

34018 SURFACE IONIZATION ON THIN LAYERS OF CALCIUM AND MAGNESIUM OXIDES. Dobretsov, L. N.; Starodubtsev, S. V.; Timokhina, Yu. I. pp 45-49 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

For surface ionization of calcium on tungsten wires the degree of ionization as predicted by the Langmuir equation should not exceed 0.04% and for magnesium it should not be >0.00003%. However ion currents considerably exceeding the expected values are found. An explanation is found in the formation of alkaline-earth oxide layers at high temperatures. Ion currents up to 5 to 6 ma/cm^2 can be obtained. The ion current depended on the thickness of the CaO layer. Analogous results were obtained with a layer of magnesium oxide on a tungsten wire. (SJR)

34019 SECONDARY EMISSION OF NEGATIVE PARTICLES ON BOMBARDING IMPURITY FILMS ON PURE METALS WITH ALKALI ELEMENT IONS. Arifov, U. A.; Ayukhanov, A. Kh.; Starodubtsev, S. V. pp 202-210 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

The purpose of this study was a special investigation of the secondary emission of negative particles from a surface on going from one pure metal (main target) to another pure metal (film) during bombardment with positive alkali element ions. The equipment consisted of an ion source, a receiving section, and an evaporator for covering the target surface with a film. A method of double modulation was used to make rapid measurements by means of which it was possible to obtain on an oscillograph screen the volt-ampere characteristics of secondary currents for each state of the target surface. Pictures were taken each 0.5 sec with an exposure of 0.2 sec. Thus it was possible to obtain secondary emission coefficients as a function of film density. Films of Na, K, Rb, and Cs on W, Ta, Mo, and Ni targets were investigated. The secondary emission of negative particles changes irregularly up to the saturation value, but this change takes place with the attainment of a maximum value at small (monoatomic) coverings. The presence of negative gas ions was shown by mass-spectrometric analysis. (SJR)

34020 ELECTRIC RESISTIVITY METHOD FOR THE STUDY OF DEFECTS INDUCED BY ELECTRON IRRADIATION IN METALS. Arbuzov, V. L.; Baldin, A. V.; Buzynov, A. E.; Klotsman, S. M.; Matvienko, A. F.; Medvedev, G. V.; Pavlov, V. A. (Inst. of Metal Physics, Moscow). Fiz. Metal. Metalloved.; 38: No. 6, 1201-1208(Dec 1974). (In Russian).

The installation and technology for the irradiation, annealing, and measurement of the electrical resistance of metals are described. With this installation the irradiation can be made at the temperature of liquid nitrogen and above and annealing can be studied on three samples simultaneously by measurement of the electrical resistance by isochronous and isothermal methods. A linear accelerator with electron energy of 3 MeV and beam current of 20×10^{-6} A was used as the electron source. The integral annealing temperatures were 160 to 420°K. During annealing the temperature was maintained with an accuracy of ±0.005°K. The ac-

curacy of the measurement of the electrical resistance was $\pm 1.5 \times 10^{-13}$ Ω cm. (tr-auth)

34021 INTERPRETATION OF EXPERIMENTS ON RADIATION DEFECT NUMBER DETERMINATION BY THE METHOD OF INVERSE SCATTERING OF CHANNELED IONS. Beloshitskii, V. V.; Gumanskii, G. A.; Kumakhov, M. A.; Tashlykov, I. S. (Belorussian State Univ., Minsk). Dokl. Akad. Nauk SSSR; 217: No. 6, 1277-1280(21 Aug 1974). (In Russian).

The reverse scattering of 1.4 MeV He ions was used to determine the number of radiation defects in crystals of pure Bi and Bi–Pb alloys irradiated with 100-keV protons. Previous studies have not taken into consideration the dechanneling on the defects. The assumptions made in the present study for the calculation of the number of defects are tabulated and include the dechanneling effect. The number of defects remaining after irradiation in calculations on one ion was 35. (JSR)

34022 STATIONARY DISTRIBUTION OF VACANCIES AND INTERSTITIALS IN IRRADIATED PLATES. Seeger, A. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Phys. Status Solidi (a); 28: No. 1, 157-168(16 Mar 1975).

The stationary distribution of vacancies and interstitials is considered in plates in which these defects are generated homogeneously by irradiation. Recombination and diffusion to the surfaces (assumed to be the only sinks) are taken into account. It is shown that this problem may be solved by quadratures if the diffusion process may be described by effective diffusion coefficients for vacancies and interstitials (which in general will be concentration-dependent). In the important special case of concentration-independent diffusion coefficients explicit solutions in terms of elliptic functions are given and discussed in detail. (auth)

Other Materials

Refer also to abstracts 32495, 32591, 32609–32611, 33294–33297, 33299, 33751, 33779, 33891, 33994, 34188, 34470, 34484, 35061, 35179, 35245, and 35522.

34023 (AD/A-000016) CHARGE-STATE EFFECTS ON ANNEALING OF ELECTRON-IRRADIATED SILICON. Deangelis, H. M.; Diebold, J. W.; Komm, D. S.; Nikula, J. V. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 22 May 1974. 29p. (AFCRL-TR-74-0239; AFCRL-PSRP-593). NTIS $3.75.

Radiation-induced defects can alter the properties of silicon and thereby degrade the performance of devices used in electronic and optoelectronic subsystems that must operate in nuclear and space radiation environments. The factors that produce or affect the stability of these defects are important considerations in developing methods for hardening devices to nuclear radiation. The annealing behavior of the E center, a prominent defect in electron-irradiated float-zone phosphorous-doped silicon, can be monitored by capacitance measurement techniques used with silicon Schottky barrier diodes. The defect charge state can be controlled during annealing by applying a reverse bias. It has been shown that although the E center is more stable in the negative charge state, it anneals more readily in the neutral charge state. It has been found that the capacitance measurement technique provides details of the properties of discrete radiation-induced defects not possible to obtain through the more conventional measurements of the hall effect, conductivity, and carrier lifetime. (auth)

34024 (AD/A-000203) THERMAL ANNEALING OF RADIATION DAMAGE IN ALKALI METAL NITRATES. Zakharov, Yu. A.; Abakumov, E. P. Translated from Izv. Tomsk. Politekh. Inst.; No. 176, 104-106(1970). 4p. (FSTC-HT-23-1102-73). NTIS $3.25.

Thermal annealing of irradiated alkali metal nitrates was studied by determining the residual and initial concentrations of nitrite ion and total NO + NO_2. The rate and extent of annealing increase with increase in free volume of the crystal. (GRA)

34025 (AD/A-000432) CORROSION AND STRUCTURAL CHANGES IN GLASS. Final Report. Hench, L. L.; Gould, R. W.; Reed-Hill, R. E.; Person, W. B.; Sanders, D. M. (Florida Univ., Gainesville (USA)). Oct 1974. Contract N00014-68-A-1073-0006. 15p.

New methods for obtaining a quantitative description of surface and bulk structural changes in glass are described. The new techniques include x-ray diffraction analysis of amorphous solids using pair function and disorder distribution functions. Application of the x-ray method to glass corrosion, thermal treatments, glass fabrication variables, and fast neutron damage is reviewed. Infrared reflection spectroscopy (IRRS) was developed in the contract as a rapid, nondestructive tool for characterizing the surface of bulk glass samples. Scanning electron microscopy with x-ray dispersive analysis and electron microprobe analysis was used to confirm interpretations. Auger electron spectroscopy with ion beam milling was also applied to glass surface corrosion analysis of ternary glass systems. Several areas of proposed research using these new methods are presented. Abstracts of 20 papers prepared during the contract are included. (GRA)

34026 (AED-CONF-74-328-023) LOW TEMPERATURE THERMAL CONDUCTIVITY OF 0.75 MeV ELECTRON IRRADIATED TYPE IIa DIAMONDS: EVIDENCE FOR INTERSTITIAL MIGRATION BELOW ROOM TEMPERATURE. Vandersande, J. W. (University of the Witwatersrand, Johannesburg (South Africa). Dept. of Physics). 1974. 13p. INIS.

From international conference on lattice defects in semiconductors; Freiburg im Breisgau, F. R. Germany (22 Jul 1974). With abstract.

The low temperature thermal conductivity of type IIa diamonds irradiated at room temperature and at 77°K differed although large interstitial aggregates were found in both. The difference between the results of the irradiations at the two temperatures is most likely due to the different instantaneous concentrations of interstitials. The results of the 77°K irradiation can only be explained if the interstitial becomes mobile between 77 and 300°K. (auth)

34027 (CEA-CONF-2813) INFLUENCE OF PORE STRUCTURE ON THE INHIBITED RADIOLYTIC CARBON DIOXIDE/GRAPHITE REACTION. Campion, P.; Lind, R.; Blanchard, R. J.; Koch, C. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France); UKAEA Reactor Group, Springfields). [nd]. 8p. (CONF-740995-1). Dep. NTIS (US Sales Only) $4.00.

From 4th international carbon and graphite conference; London, UK (23 Sep 1974).

The effects of pore structure on methane-inhibited radiolytic oxidation processes in graphite were studied. A variety of coolant composition were employed during the project but discussion is restricted to two coolant compositions: 700 vol ppM methane/1% carbon monoxide and 130 to 170 vol ppM methane/2% carbon monoxide. Hydrogen and moisture concentrations were maintained constant at 200 vol ppM. A typical set of results obtained with thermally oxidized specimens in the presence of a 700 vol ppM methane/1% carbon monoxide coolant is shown. Results show that the only pore structure parameter measurement which can be linked quantitatively to inhibited radiolytic oxidation rates is mercury pore size distribution, and that the majority of inhibited radiolytic oxidation takes place in the 0.05 to 2 μm pore entrance diameter range. (auth)

34028 (CEA-CONF-2814) EFFECT OF COOLANT COMPOSITION ON THE RADIOLYTIC CARBON DIOXIDE/GRAPHITE REACTION. Campion, P.; Blanchard, A.; Lind, R.; Blanchard, R.; Koch, C. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France); UKAEA Reactor Group, Springfields). [nd]. 9p. (CONF-740995-2). Dep. NTIS (US Sales Only) $4.00.

From 4th international carbon and graphite conference; London, UK (23 Sep 1974).

Results of experiments are presented on radiolytic oxidation of nuclear grade graphites under variably imposed pressure drop conditions and simultaneous changes in coolant CO_2 coolant composition. A model of oxidation rates is proposed in which the surface inhibition is superimposed on the gas-phase active oxygen capture processes. The model is used to predict that the graphite pore reactivity decreases as the pore diameter increases. (JRD)

34029 (CEA-CONF-2892) ELECTRICAL PROPERTIES AND ENERGY LEVELS IN ELECTRON-IRRADIATED N-TYPE InP. Leloup, J.; Djerassi, H.; Albany, H. J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service d'Electronique Physique). [nd]. 17p. (CONF-740729-20). Dep. NTIS (US Sales Only) $4.00.

From meeting on application of lattice defects in semiconductors; Freiburg, F. R. Germany (22 Jul 1974).

N-type doped InP was irradiated by 3 MeV-electrons at 15 or 50°C. The Hall coefficient and electrical resistivity were measured from 10 to 300°K before and after each irradiation. The effect of irradiation is to give rise to a decrease of the carrier concentration n_0 and an increase of the resistivity with increasing the integrated flux ϕ. In addition to acceptor centers, donor centers are also introduced by irradiation. This has been particularly observed in sample with initial $n_0 = 1.6 \times 10^{16}$ cm^{-3} irradiated at 15°C. At high ϕ (4 to 6×10^{16} electrons/cm^2), two donor centers are observed: shallow levels (~4 MeV) related to the initial donor impurities, and a deep energy level estimated to be of about 130 MeV. The temperature of irradiation at 15 or 50°C is found to have an important effect, and an annealing stage is observed to take place in a temperature interval around 50°C. (auth)

34030 (CEA-CONF-2896) MORPHOLOGY AND STRUCTURE OF PYROCARBON DEPOSITED IN A FLUIDIZED BED. Isotropic and Anisotropic Pyrocarbons: Effects of the Irradiation. Pelissier, J.; Lombard, L. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). 28 Aug 1974. 16p. (CONF-7410102-1). Dep. NTIS (US Sales Only) $4.00.

From reunion of the group "Pyrocarbons" of QCWP-Dragon; Vienne, France (14 Oct 1974).

Transmission electron microscopic studies were made of pyrocarbon deposited under different conditions onto HTR fuel particles. Growth features and porosities of both isotropic and anisotropic pyrocarbons were identified. Correlation was made between the structure of isotropic pyrocarbon and that of soots from propene pyrolysis. Effects of a Rapsodie irradiation to 4.6×10^{21} n/cm^2 on the structure of an isotropic pyrocarbon were studied. (11 figures) (DLC)

34031 (CONF-750403-1) INFLUENCE OF THE STRUCTURE AND THE INNER SURFACE AREA ON THE IRRADIATION RESISTANCE OF PYROCARBON COATINGS. Krautwasser, P.; Luhleich, H.; Hoven, H.; Pollmann, E.; Yust, C. S. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe und Heisse Zellen; Olin Mathieson Chemical Corp., New Haven, Conn. (USA)). 1975. 10p. Dep. NTIS $4.00.

From reactor congress; Nuremberg, F. R. Germany (8 Apr 1975).

The relations between the type and proportion of the disorganized structures in pyrolytic carbon and irradiation resistance were investigated. It was found that the description of the individual structural components existing in pyrocarbon by means of TEM, plasma oxidation, and x-ray investigations are in good agreement. The desired structural component for irradiation resistance is evidenced by high porosity and large inner surface area, high oxidation rate, and low degree of order. The determination of the proportion and the distribution of these structures allows, with the usual particle designs, an uncontradicted prediction of the irradiation resistance. (auth)

34032 (FZK-161-1) INVESTIGATION OF COMBINED EFFECTS OF RADIATION AND VACUUM AND OF RADIATION AND CRYOTEMPERATURES ON ENGINEERING MATERIALS. Volume I. Radiation-Vacuum Tests. Annual Report, 9 November 1961–8 November 1962. Kerlin, E. E. (General Dynamics/Fort Worth, Tex. (USA)). 5 Jan 1963. 340p. Dep. NTIS $20.00.

A series of tests was performed to measure the combined effects of nuclear radiation and vacuum on a group of nonmetallic materials that are considered for use in nuclear-powered space vehicles. This group consisted of materials classified as adhesives, seals, thermal insulations, electrical insulations, potting compounds, dielectric materials, lubricants, structural laminates, and thermal-control coatings. Typical tests performed on material specimens included lap-shear strength, ultimate tensile strength, ultimate elongation, stress-strain characteristics, compressive strength, weight loss, lubricity, color changes, and spectral reflectivity. Two vacuum systems having pumping speeds in excess of 3000 liters/s at 10^{-6} torr were designed by General Dynamics and built by Consolidated Vacuum Corporation for use in these irradiations. Special dynamic test equipment was built for testing materials in vacuum after irradiation. Measured properties of the materials as a function of integrated neutron flux and gamma dose are reported, and recommendations for use of the various materials in nuclear-powered spacecraft are made. (auth)

34033 (FZK-161-2) INVESTIGATION OF COMBINED EFFECTS OF RADIATION AND VACUUM AND OF RADIATION AND CRYOTEMPERATURES ON ENGINEERING MATERIALS. Volume II. Radiation-Cryotemperature Tests. Annual Report, 9 November 1961–8 November 1962. Smith, E. T. (General Dynamics/Fort Worth, Tex. (USA)). 5 Jan 1963. 260p. Dep. NTIS $16.00.

A series of tests was performed to measure the combined effects of nuclear radiation and cryotemperatures on a group of nonmetallic spacecraft materials. This group consisted of materials classified as adhesives, seals, thermal insulations, electrical insulations, structural laminates, and thermal-control coatings. Typical tests performed on specimens prepared from the materials included lap-shear strength, ultimate tensile strength, ultimate elongation, stress-strain characteristics, and compressive strength. Special test equipment to submerge the specimens in liquid nitrogen or liquid hydrogen during irradiation and to subsequently perform the tests is described. Measured properties of the materials as a function of integrated neutron flux and gamma dose are reported and recommendations for use of the various materials in nuclear-powered spacecraft are made. (auth)

34034 (IPPJ-DT-43) MEASUREMENT OF GAS EMISSION RATE OF ELECTRIC INSULATING MATERIALS. Ootsuki, S.; Akaishi, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1974. 10p. (In Japanese). INIS.

The thermal gas emission rate of vinyl chloride, teflon, Delrin and bakelite for vacuum containers was measured and the gas emission of vinyl chloride owing to electron impact was tested, to determine their usability for replacement of glass tubes of plasma containers in toroidal theta pinch experiments. The thermal gas emission rate can be calculated from the equation $Q = Q_0 \exp(-E/RT)$ at 300°K, where Q is total gas emission rate in Torr l/sec, T is absolute temperature, and E is the activation energy of gaseous diffusion. The gas emission rate $q = Q/A$, where A is the exposed area of specimen. The principle of this measuring apparatus is to heat specimens in a thermal bath, after degassing from the wall of specimen containers. The background gas from the container is so small amount that E can be determined from the plot of Q and 1/T. Electron bombardment was carried out by coating the inner surface of cylindrical vinyl pipes with gold of 2,000 Å thick to make the pipes conductive. As the results, these experimental data on the thermal gas emission rate coincide with known data, and about 10 kcal/mol activation energy for separation shows that the main emitted gas is water contained in the materials. Consequently, the gas emission from organic materials is believed to continue for long hours, so that it is difficult to use them as discharge tubes. Vinyl chloride is not suitable for the material of pinch experiment because of 0.37 gas molecules emitted/electron at 800 eV. (JA)

34035 (JAERI-M-5567, pp 22-25) SOLID STATE PHYSICS STUDIES WITH HEAVY IONS FROM JAERI 2 MV Van de GRAAFF ACCELERATOR. Doi, K. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Solid state studies recently carried out at JAERI with heavy ions from a 2 MV Van de Graaff accelerator are described. They include studies of color center formation in LiF and NaF crystals with N^{2+} ion bombardment, and channeling measurements with H^+ and He^+ ions along the [00,1] axis of pyrolytic graphite. (auth)

34036 (KHFTI-73-26, pp 53-55) CHANNELING OF HIGH-ENERGY POSITRONS. Grishaev, I. A.; Kasilov, V. I.; Kovalenko, G. D.; Krinitsin, A. N.; Morokhovskii, V. L.; Shramenko, B. I.; Fisun, A. N. (Physical-Technical Inst., Kharkov). 1973. (In Russian).

The results of observations of the effect of channeled positrons with $E_{max} = 1$ GeV on a 0.64-mm-thick Si monocrystal are given. The crystal was oriented to the positron beam by a goniometer. The orientation dependence was measured when the crystal was turned around the [001] axis, in which the angle of turn $\phi = 0$ corresponds to the location of the crystal when the [110] axis is directed along the positron beam axis. The normal to the surface of the layers made an angle of 1° with the crystal [110] axis. (INIS)

34037 (PB-237180) IMPACT RESISTANCE OF REINFORCED CONCRETE AS A PROBLEM OF CONTAINMENT. Burgess, W. M.; Campbell-Allen, D. (Sydney Univ. (Australia)). Aug 1974. 37p. (R-251). NTIS $3.75.

The resistance of reinforced and prestressed concrete to missiles is a real problem in the design of containment structures. Missiles can arise internally from fractured piping and externally from hurricanes, aircraft, and hostile action. A series of tests on model slabs has been carried out in which the slabs have been subjected to falling projectiles. In general it is shown that premature flexural failure must be guarded against either by sufficient reinforcement or by prestressing and that additional reinforcement to control shear is also required. (GRA)

34038 (SAND-75-0043) ULTRASONIC VELOCITY DETERMINATIONS IN ATJ-S GRAPHITE COMPOSITE FOR 70°F TO 6100°F. Gieske, J. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1975. Contract AT(29-1)-789. 18p. Dep. NTIS $4.00.

The temperature dependence of the ultrasonic longitudinal and shear velocities in ATJ-S graphite composite were measured from 70 to 6100°F. A pulse echo technique was used with $^3/_4$-in. diameter rods of 13-in. length. The rods were machined to provide a 2-in. indexed region of the rod which was placed into the hot zone of the furnace for which the velocity measurements were made. (auth)

34039 (TID/SNA-1279) RADIATION EFFECTS ON TEFLON AND TEFLON-BASED MATERIALS AT LIQUID-HYDROGEN TEMPERATURES. Weleff, W.; McQueen, H. S.; Emmons, W. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Jun 1964. 26p. Dep. NTIS $4.50.

Three materials were tested in sheet form: Teflon, Armalon (a laminate of glass cloth impregnated with Teflon), and Rulon A

(fiber-filled Teflon). Effects of reactor irradiation at –423°F on the –423°F tensile properties (strength, elongation, stress-strain) were determined at doses of approximately 4×10^8 and 5×10^8 ergs/g. Results show that the materials are usable up to the max dose. (DLC)

34040 (WANL-TME-891) STRUCTURAL GRAPHITES WITH HIGH THERMAL EXPANSION. Kachur, V. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 9 Sep 1964. 63p. Dep. NTIS $6.25.

Graphite grades with relatively high and isotropic thermal expansion characteristics were investigated for the advanced NERVA reactor (NRX-B) components. Two molded grades (H-205-85 and 1477) and two extruded grades (A-122-S and A-175-S) were examined for thermal expansion behavior between the room temperature and 2500°C (4530°F) and results compared with those of several refractory carbides. At elevated temperatures, the average coefficient of thermal expansion for all graphites evaluated was between 2.5 and 3.8 μ in./in.°F, with an anisotropy factor of about 1.2. Structurally, these graphites are promising materials: the average with-grain tensile strength at room temperature was as high as 4275 psi for grade A-122-S, while the compressive strength of grade 1477 was 16,200 psi. The lowest average values, obtained for the coarse-grained A-175-S grade, were 2640 for the tensile and 8280 psi for compressive strengths. The largest stock size tested was an 18-inch diameter extrusion of the A-175-S grade, having a length of 72 inches. Representative stress-strain curves were determined together with the supporting data on electrical resistivity and specimen density. Extruded Grade A-122-S was x-rayed to define its radiographic quality, and the two molded grades were analyzed for impurities. (22 figures, 6 tables) (auth)

34041 (WANL-TME-1605) CONSOLIDATION OF RECONSTITUTED PYROLYTIC GRAPHITE INTO THERMAL INSULATING SHAPES. Blay, J. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1967. 63p. Dep. NTIS $6.25.

The next generation of NERVA Reactors has some conceptual designs requiring highly complex shaped thermal insulators. Although in some cases they are poorly defined at the moment, it is becoming increasingly obvious that because of the high reliability and sophistication designed into NERVA components, a few will certainly be extremely difficult to manufacture from vapor deposited pyrolytic graphite. A cooperative program was initiated with interested manufacturers of conventional pyrolytic graphite. The purpose was to evaluate process parameters and obtain thermal and mechanical properties of the following four techniques for consolidating reconstituted pyrolytic graphite that appeared to lend themselves to fabricating complex insulating shapes including adhesive bonded grafoil laminates, hot pressure bonded grafoil laminates, adhesive bonded and consolidated exfoliated pyrolytic graphite (foam), and adhesive bonded and consolidated annealed pyrolytic graphite (flake). Products resulting from these four manufacturing techniques were evaluated for across-the-thickness thermal conductivity, hot flowing hydrogen corrosion resistance, along-the-length and across-the-thickness thermal expansion, compressive strength, physical resilience, and manufacturability. Comparisons of the various properties with vapor deposited pyrolytic graphite were made. It was concluded that the hot pressure bonded grafoil and the adhesive bonded consolidated foam fragments are the most promising for thermal insulating applications in hot hydrogen environments. Manufacturing development is required for both materials. The adhesive bonded grafoil product, because of its exceedingly poor hydrogen corrosion resistance at 3000°F, should be restricted to 2000°F maximum temperatures, but little, if any, manufacturing development is required. This material also looks promising for application in future NERVA reactors. There appears to be no future within the NERVA program for the adhesive bonded annealed pyrolytic graphite flake consolidating technique because of its poor physical integrity at low pressing densities and its exceedingly high thermal conductivity when pressed to a high density. (auth)

34042 (WANL-TME-1992) EROSION OF GRAFOIL INSERT. Development Test Report. Data Item T-119. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1970. 68p. Dep. NTIS $6.50.

A test was conducted to determine if Grafoil would erode in a R-1 reflector environment. Grafoil is used as the thermal insulation on the inside surface of the R-1 reflector designs. Unlike previous designs, the Grafoil is exposed to hydrogen gas flowing through the lateral support seal system. Ten samples were tested under various conditions. Even at gas velocities four times (400 ft/sec) those anticipated in the reactor, there was negligible erosion. It was concluded from these tests that Grafoil would not deteriorate due to hydrogen gas flow over the exposed surfaces in the R-1 reactor. The test did reveal another potential problem related to rapid depressurization. Blisters were noted on the surface of samples subjected to rapid depressurization. Additional tests are planned to investigate this problem based on reactor operating procedures. (auth)

34043 (WANL-TMI-721) COMPRESSION AND BENDING TESTS OF GRAPHITE SAMPLES: WR 41:41:26-10W; WR 41:41:26-12W; WR 41:41:26-13W. Schreiber, J. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 13 Aug 1963. 12p. Dep. NTIS $4.00.

A series of mechanical tests was conducted to determine the relative strengths and deformations of various grades of graphite. The specimens were in the form of short cylindrical pins and they were subjected to both compression and three-point bending tests. Four grades of graphite (ATJ, PDS 30020, National TS-454, and PDS 30022-1) were evaluated. Maximum loads and deflections were recorded for each of the 67 pins tested. (auth)

34044 (WANL-TMI-879) EXPOSURE OF VARIOUS MATERIALS TO LIQUID HYDROGEN. Edmiston, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 2 Dec 1963. 7p. Dep. NTIS $4.00.

Results of cryogenic tests on nylon, tie straps, shrinkable tubing, bonded strain gages, and wire potted in graphite are presented. The one component that showed a physical change after liquid hydrogen soak was the shrinkable tubing covering a wire junction—axial splitting occurred in the tubing. (JRD)

34045 (WANL-TMI-945) GRAPHITE THREAD STRENGTH USING HELI-COIL AND TAP-LOK INSERT REPAIR PROCEDURE. Kotulak, F. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Feb 1964. 8p. Dep. NTIS $4.00.

Tests were conducted to obtain data which will determine the maximum torque and the optimum fastening strength of graphite threads repaired using inserts for damaged tapped holes in the NERVA inner reflector. It was found that varying the torque values used in installing the bolt in the inserts has no apparent effect on the ultimate thread strength. Solid thread inserts appear to have greater consistency in thread strength than heli-coil inserts, although there was not any significant difference in maximum thread strength in either case. Tap drill size, however, has considerable effect on the thread strength. Using a tap drill only a few mils undersize can reduce the effective thread strength as much as 30 to 50%. (auth)

34046 (WANL-TMI-1404) EXAMINATION OF THE KINETICS OF THE GRAPHITE–HYDROGEN REACTION. Bridges, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Feb 1965. 26p. Dep. NTIS $4.50.

A literature review on hydrogen corrosion of graphite is presented. Based on data and information found in the literature reaction rates for graphite hydrogenation are predicted. Information and data are included on reactions in flow systems, kinetics of complex reactions, and kinetics of H_2–graphite reactions. (auth)

34047 (WANL-TMI-1542) FAILURE MODE ANALYSIS OF THE TE MODULE. Ottenheimer, F.; Wagner, G. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 Sep 1965. 17p. Dep. NTIS $4.00.

An analysis of component failure modes in a thermoelectric module designed for use in compact thermoelectric converters is presented. Failure of insulation, electric conductors, thermal conductors, washer materials, welds, cladding, and other functional materials is examined in relation to operational reliability. (JRD)

34048 (WANL-TR-6584) TRIP REPORT TO OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, TENNESSEE. Stancampiano, P. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 Jan 1971. 5p. Dep. NTIS $4.00.

The ORNL Applied Mechanics Section reviewed their most recent unpublished work on graphite failure criteria. Salient items from previously reported ORNL work with graphite were reviewed in summary form. The final topic was a discussion of how to proceed with the NERVA fuel analysis with immediately available properties and analytic tools. No real criticisms of the current WANL approaches were made. Some codes available now or in a short time were suggested for our consideration by Dr. Greenstreet. ORNL agreed to give some attention to the coating-matrix interaction stress analytic representation. (auth)

34049 (WANL-TR-6659) TRIP REPORT TO BATTELLE MEMORIAL INSTITUTE, COLUMBUS, OHIO. Gaal, P. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Jul 1971. 3p. Dep. NTIS $4.00.

The testing program is progressing very well. The excellent cooperation on the part of Battelle personnel is instrumental in generating meaningful data in this program, and predictably will surpass the initial goal set for this investigation. They are in need of more specimens. So far, WANL had supplied only three complete specimen pairs, the rest of the samples are only half of a pair. Unless the missing material specimens are supplied within a reasonable time, serious delays may occur in the program. (auth)

34050 (Y-1454) SHIELDING STUDIES: NEUTRON IRRADIATION DAMAGE TO A LITHIUM HYDRIDE COMPACT. Hamill, C. W.; Waldrop, F. B. (SEE CODE-9500170 Union Carbide Corp., Oak Ridge, Tenn. (USA). Y-12 Plant). 14 Jan 1964. Contract W-7405-eng-26. 20p. Dep. NTIS $4.00.

Declassified 31 Aug 1973.

A sample of lithium hydride was prepared at the Y-12 plant in Oak Ridge for irradiation at the General Dynamics-Convair facility in Fort Worth. After exposure to 1.6×10^{17} n/cm^2 for 44 hours and 40 minutes, the specimen was returned to Oak Ridge for examination. Results indicate some swelling, but not enough to cause concern in the presently proposed SNAP shields. (auth)

34051 EFFECT OF DEEP MIGRATION OF RADIATION-INDUCED DEFECTS ON SILICON EXOEMISSION. Panteleev, V. A.; Chernyakhovskii, V. V.; Ershov, S. N. (Gorky State Univ., USSR). Sov. Phys.-Solid State (Engl. Transl.); 16: No. 7, 1411-1412(Jan 1975).

Translated from Fiz. Tverd. Tela; 16: No. 7, 2151-2153(Jul 1974).

Results of analysis of exoelectron emission from Si samples bombarded by W ions are presented showing that the emission is caused by the diffusion of point defects toward the surface. As the point defects approach the surface from the interior of the crystal, new active centers are formed. Decay of the new active centers explains the appearance of minima found in room temperature kinetic emission curves. (JRD)

34052 EFFECT OF ANNEALING ON THE ETCHING OF THE RADIATION DAMAGES IN MICAS. Nagpal, M. K.; Nagpaul, K. K. (Kurukshetra Univ., India). Indian J. Phys.; 48: No. 8, 712-714(Aug 1974).

Annealing experiments on micas were performed to learn the behavior of etching phenomenon associated with thermally annealed radiation damages. It was observed that damages can be recovered by overetching and the probability for revealing the healed damages by overetching increases with the amount of annealing of the samples. (auth)

34053 ELECTRON SPIN RESONANCE STUDY OF γ-IRRADIATED SINGLE CRYSTALS OF SUCCINIC ANHYDRIDE. Kumar, S. (Univ. of South Carolina, Columbia). Indian J. Phys.; 48: No. 8, 746-747(Aug 1974).

Electron Spin Resonance spectra of γ-irradiated single crystals of succinic anhydride ($CH_2CO-O-COCH_2$) have shown the formation of ($CHCO-OCOCH_2$) radicals as the secondary product. The same radical is believed to have been formed in succinic acid as previously reported. The crystal structure of succinic anhydride is orthorhombic. Space group is $P2_12_12_1$ with four molecules per unit cell. The spectra was taken in three mutually perpendicular planes of the crystal at room temperature on a reflection type X band ESR spectrometer operating at 9.5 kMHz/s with 100 kHz/s modulation frequency. The main features of the spectra arise from the presence of two nonequivalent radical sites. An eight line pattern of equal intensity can be traced out at most orientations of the crystal with respect to the applied dc magnetic field which indicates the interaction of the unpaired electron with three nonequivalent protons. Therefore, the methylene protons on the radical are nonequivalent similar to the case of succinic acid. Satellite lines were also observed at several orientations of the crystal. (auth)

34054 THE ROLE OF DISLOCATION AS SINKS FOR H CENTERS IN LiF. Yabe, M. (William Marsh Rice Univ., Texas (USA)). J. Phys. Soc. Jap.; 36: No. 5, 1383-1389(May 1974).

The effect of γ-irradiation at liquid nitrogen temperature on the low temperature internal friction of compressed LiF crystals was studied by the ultrasonic pulse method at a frequency of 10 MHz. The internal friction is increased substantially in compressed LiF after a 5.8×10^5r dosage of γ-rays at liquid nitrogen temperature. It was noted that this enhanced internal friction decreases during isochronal annealing at a low linear rate between 83 K to 110 K. The kinetics of this annealing process is analyzed. It is concluded that a fraction of the H centers introduced in LiF by the γ-irradiation diffuse to dislocations with a migration activation energy of 0.138 ± 0.004 eV. The H center appears to pin the dislocation in the temperature region between 83 K and 110 K. (auth)

34055 ATOMIC DISPLACEMENTS BY IRRADIATION IN GRAPHITE. Iwata, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Nippon Genshiryoku Gakkaishi; 16: No. 5, 231-240(May 1974). (In Japanese).

A review is presented on the experimental studies of atomic displacements, i.e., the production of lattice defects in graphite by irradiations with energetic particles. The following fundamental properties of defect production are discussed: (1) The anisotropic threshold energy for atomic displacement, (2) the displacement cascade process, and (3) the effect of irradiation temperature on atomic displacements. (auth)

34056 IRRADIATION EFFECTS OF EPOXY RESIN CURED WITH ACID ANHYDRIDE. Suzuki, Y.; Tsunoda, S.; Shibayama, K. (Mitsubishi Electric Corp., Amagasaki, Hyogo (Japan). Central Research Lab.). Mitsubishi Denki Giho; 48: No. 6, 773-776(Jun 1974). (In Japanese).

In this paper is described an attempt, by dynamic mechanical and dielectric measurement, to characterize irradiation effects of epoxy networks cured with various kinds of acid anhydrides. In the case of epoxy resin cured with phtalic anhydride, little irradiation effect was found. This is attributable to excellent radiation stability of the phenyl ring. With hexahydrophtalic anhydride, it can be concluded that the radiation damage is simple chain scissions; in the case of tetrahydrophtalic anhydride, it was tentatively assumed that unsaturated bonds of the cyclohexene rings can be changed to the crosslink points. (auth)

34057 THE COMPLEX H CENTER IN KCl-KI CRYSTALS. Katsuyama, T.; Wakita, S.; Hirai, M. (Tohoku Univ., Sendai (Japan). Dept. of Physics). J. Phys. Soc. Jap.; 36: No. 4, 1058-1064(Apr 1974).

New absorption bands have been observed in KCl-KI (10 mol%) crystals x-rayed near liquid helium temperature and attributed tentatively to complex $H(ICl_2^-)$ centers. The main absorption band is located at 425 nm and a sub-band at 800 nm with the half width of 0.43 eV and 0.21 eV, respectively. The dichroic property of the bands is consistent with that of a center with its internuclear axis along ⟨110⟩ directions. The center is thermally reoriented above about 70°K with $E_{reori} = 0.10 \pm 0.01$ eV and decomposed above 190°K with $E_{dest} = 0.16 \pm 0.01$ eV. The peak positions, the half width, the polarization, the oscillator strength and the thermal properties of the bands are qualitatively discussed by a model of the heteronuclear diatomic molecule. The qualitative analysis suggests that the hole of the complex H center is found having a large probability around the 1 atom as one of constituents. (JA)

34058 IONIZATION OF ALKALI HALIDE SALTS ON A METAL SURFACE AND IN A MOLECULAR BEAM. Arifov, U. A.; Starodubtsev, S. V.; Shuppe, G. N. pp 49-64 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

Experiments were run to determine the emission of negative ions of an alkali halide salt from the surface of an incandescent metal (Mo, Ni), and secondly to determine the negative current during ionization of the molecules of an alkali halide salt (NaCl, KCl, KI) in a molecular beam as a result of electron collisions. The experimental details and methods of measuring the above values are described in detail. Sufficient ionization of NaCl, KCl, and KI is found in a molecular beam on collision with electrons so that it is necessary to take it into account on observation of surface ionization by directing a molecular beam to an incandescent wire. This phenomenon can be a significant source of error if not taken into account. (SJR)

34059 USE OF A MAGNETIC MASS-ANALYZER FOR STUDYING SECONDARY ION EMISSION OF DIELECTRIC FILMS. Lovtsov, V. M.; Starodubtsev, S. V. pp 139-143 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

The results are presented of investigations carried out by means of a magnetic mass analyzer on ions knocked out of dielectric KCl and NaCl films by a beam of positive potassium ions. The primary K^+ ions were obtained by heating a spiral coated with KCl. Ions that are knocked out or scattered by the target exit through an opening in a collecting network, and are accelerated by a potential of 1000 V in a direction towards the inlet tube to a mass analyzer. The following qualitative conclusions can be drawn. The main form of positive secondary particles is ions knocked out of the target and not primary particles scattered by the target. The negative secondary emission from NaCl films contains a significant amount of negative chlorine ions

in its composition. The absence of scattered particles in the secondary emission indicates that the main part of the primary ions penetrate the surface layers and exit into the target. The formation of secondary ions can be considered as a dissociation of target molecules by collision with fast ions of the primary beam. (SJR)

34060 DEPTH OF PENETRATION OF AN ION BEAM IMPINGING ON A CRYSTAL. Voznesenskii, V. L.; Nosenko, B. M.; Starodubtsev, S. V. pp 150-155 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

It is established that the penetration depth (λ) of an ion into a crystal depends on the energy of the ion almost linearly, and that the value of λ depends insignificantly on the type of ion (Na, K, or Cs). Formulas were derived and values of λ were calculated. At an ion energy of 2.4 keV the value of λ (in Angstroms) is 7 ± 1 for Na^+ and 6 ± 2.5 for Cs^+. At an energy of 4.2 keV the λ values are 12 ± 2 for Na^+ and 11 ± 2.4 for Cs^+. At an ion energy of 6.0 keV the calculated λ values are 18 ± 3 for Na^+, 15 ± 3 for K^+, and 16 ± 5 for Cs^+. (SJR)

34061 SPECTRAL COMPOSITION OF LIGHT EMISSION FROM CRYSTAL PHOSPHORS DURING ION BOMBARDMENT. Voznesenskii, V. L.; Nosenko, B. M.; Revzin, L. S.; Starodubtsev, S. V.; Yagudaev, M. D. pp 155-160 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

The results are presented of investigating the emission spectra of Willemite Zn_2SiO_4 (2% Mn) and the sulfide ZnS (0.06% Ag) on excitation with light, electrons, and ions. A luminescent screen is excited by a focussed electron beam, and the cathode luminescence spectrum is photographed a number of times with successively increased exposures. Then the screen is excited by a focussed ion beam, and the ion-luminescence spectrum is also photographed. When the brightness of the luminescent spot has decreased because of phosphor aging a factor of three to four, the screen is rotated a little to expose a new place on the screen. The spectra showed that phosphor aging during ion irradiation is not accompanied by a change in the emission spectrum. The ions Li^+, Na^+, K^+, and Cs^+ were used for bombardment. No change in emission spectrum could be observed with Willemite or zinc sulfite. (SJR)

34062 EFFECT OF GAMMA IRRADIATION ON THE ELECTRICAL CHARACTERISTICS OF VERY PURE SILICON. Starodubtsev, S. V.; Mikhaelyan, B. M.; Lyutovich, A. S.; Sinyukov, V. A.; Suvorov, A. N. pp 262-268 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

Silicon samples purified by zone melting were subjected to Co-60 gamma irradiation, and measurements were taken on the Hall effect and electrical resistance in the temperature interval from 160 to 330°K. A decrease in Hall mobility with increasing dose is observed. A decrease in concentration of main carriers as a function of irradiation dose was found. A gradual increase in concentration of holes with increasing dose is observed. (SJR)

34063 COLOR CENTERS IN SINGLE CRYSTAL LITHIUM FLUORIDE IRRADIATED WITH PROTONS. Starodubtsev, S. V.; Spirin, G. S.; Islamov, A.; Domoryad, I. A. pp 279-283 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

The effect of irradiation with 100-keV protons on the optical properties of LiF is investigated. Transmissions and absorption coefficients were determined. Absorption bands in the ultraviolet part of the spectrum are observed at 408, 468, and 530 mμ. A luminescence peak is found in unirradiated samples at 570 mμ. This peak is shifted monotonically to the side of greater wavelengths with increasing radiation dose. This behavior indicates an interaction between various color centers and luminescence centers. All the irradiated samples maintained their color for a period of one month, but annealing of the samples at 450°C completely discharged the color in 8 to 10 min. (SJR)

34064 CHANGE IN THE MICROHARDNESS OF AMORPHOUS SELENIUM ON GAMMA IRRADIATION. Starodubtsev, S. V.; Domoryad, I. A. pp 283-285 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

Unirradiated samples of amorphous selenium showed a microhardness of 403 kg/mm² with an indentation load of 20 g. Samples were irradiated under dry conditions in a gamma irradiator. The microhardness increased monotonically with increasing dose, and attained a value about 25% greater than the initial value at a dose of 2×10^8 r that can be considered the saturation dose. Storage of the samples at room temperature over a period of six months showed no changes in microhardness. Annealing at 150°C removed the induced changes in 10 to 15 minutes. (SJR)

34065 NITROGEN IMPLANTED GERMANIUM: DAMAGE, LATTICE LOCATION, AND ELECTRICAL PROPERTIES. Campbell, A. B. (McMaster Univ., Hamilton, Ont.); Mitchell, J. B.; Shewchun, J.; Thompson, D. A.; Davies, J. A. Can. J. Phys.; 53: No. 3, 303-309(1 Feb 1975).

The radiation damage, implanted atom location, and electrical properties of nitrogen implanted germanium were studied following anneals in the temperature range of 300-700°C. Helium ion backscattering was used to measure the damage while two nuclear reactions, the $^{14}N(d,\alpha)^{12}C$ and the $^{15}N(p,\alpha)^{12}C$, were used together with channeling techniques for the atom site location study. The results indicate that ~85% of the implanted nitrogen was located on nonsubstitutional sites, and also that the nitrogen did not outdiffuse from the germanium for anneals as high as 700°C. The I-V characteristics of mesa structures formed in the implanted germanium indicate that nitrogen had not become a donor in germanium. (auth)

34066 RECOMBINATION RADIATION OF SYNTHETIC SEMICONDUCTOR DIAMONDS. Kerimov, O. M.; Podsosonnyi, A. S.; Slesarev, V. N.; Chmykhov, A. S. (Inst. of High Pressure Physics, Moscow). Dokl. Akad. Nauk SSSR; 220: No. 3, 564-567(21 Jan 1975). (In Russian).

The luminescent properties of semiconductor synthetic diamonds in the uv spectral region during excitation by a fast electron beam were studied. The studies were made on both Al-alloyed and unalloyed synthetic diamonds. Even with deep penetration of the electrons into the diamond crystal the temperature is increased only insignificantly. The spectrum of the Al-alloyed diamond at 350°K is similar to the radiation spectrum of natural diamonds in the short-wave part of the spectra. Noticeable luminescence was not detected in the unalloyed diamond. The scheme of the luminescence spectrum of synthetic diamonds is given. (JSR)

34067 CARBON BLACK STRUCTURE REDUCTION USING A URANIUM ADDITIVE. Vanderveen, J. W. (to Phillips Petroleum Co.). US Patent 3,864,455. 4 Feb 1975. Filed date 10 Oct 1972. 4p.

Structure of carbon black is reduced by the addition of uranium to the carbon black forming zone. (Official Gazette)

34068 APPLICATION OF RADIATION ON COMPOSITES CONTAINING INORGANIC COMPOUNDS. Shigematsu, T. (Japan Atomic Energy Research Inst., Takasaki, Gunma. Takasaki Radiation Chemistry Research Establishment). Radioisotopes (Tokyo); 23: No. 7, 409-416(Jul 1974). (In Japanese).

The field application of radiation on composites containing inorganic and organic compounds is limited to the following three systems; composites of glass fiber and synthetic resin, those of concrete and monomer, and those of sulfur contents and plastic. As regards these three systems respectively, material composition, composition ratio, physical property, and improvement of processing technology for the effect of radiation are described. From the practical of view, comparison between the cost of irradiation and that of heat and catalytic process, and balance between the cost and the efficiency etc. have been investigated. In future, the development of application of radiation on the composites can be anticipated on account of the practical value in these materials. (JA)

34069 STRUCTURE AND HYDROGEN SELF-DIFFUSING MECHANISMS IN THE CERIUM-HYDROGEN SYSTEM. Lileeva, Yu. Ya.; Podd'yakov, V. N.; Malyuchkov, O. T.; Kost, M. E. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 1, 128-131(1975).

The splitting of the proton magnetic resonance spectrum into two lines in single-phase cerium hydrides was detected in the composition regions from $CeH_{2.0}$ to $CeH_{3.0}$ in the temperature region from room temperature to that of liquid nitrogen. The spectral splitting is explained by the presence of two mechanisms of hydrogen diffusion. The diffusion activation energies were determined for each process, dependent on the hydrogen concentration in the hydride. The experimentally measured values of the diffusion activation energies were compared with the values calculated on the basis of the Thomas-Fermi model. (tr-auth)

34070 CRYSTAL SYSTEMS AND LATTICE CONSTANTS OF PEROVSKITE-TYPE COMPOUNDS $BaThO_3$ AND $Ba_2(BaU)O_6$. Nakamura, T. (Tokyo Inst. of Tech. (Japan). Research Lab. of Engineering Materials). Chem. Lett. (Tokyo); No. 5, 429-434 (May 1974).

$BaThO_3$ had an orthorhombic lattice (a = 6.345 Å, b = 6.376 Å, C = 8.992 Å) with four pseudomonoclinic perovskite units (a' = c' = 4.498 Å, b' = 4.496 Å, β = 90°17'). $Ba_2(BaU)O_6$ was a tetragonal, ordered perovskite (a = b = 6.286 Å, c = 8.972 Å). Ahren's radius of octahedral Ba^{2+} in $Ba_2(BaU)O_6$ was evaluated to be 1.16 Å via a lattice parameter variation versus radius of M^{4+} ion in perovskites $BaMO_3$. (auth)

34071 SECONDARY ELECTRON EMISSION FROM SOLID SURFACES BY BOMBARDMENT WITH CHARGED PARTICLES. Kanaya, K.; Ono, S. (Kogakuin Univ., Tokyo (Japan)). Jap. J. Appl. Phys.; 13: No. 6, 944-949(Jun 1974).

Based on the power potential law between incident ions and lattice electrons, a universal range curve of positive ions penetrating into solid targets due to electronic collisions is derived as a function of the reduced energy. Based on the assumption that the secondary electrons released in the material are proportional to the energy loss, and following the absorption law of Lenard type after their dislodgement, the energy dependence of the secondary electron yield can consistently be obtained as a function of the reduced energy. The maximum yield of the secondary electrons at the characteristic energy is derived which depends on the range due to electronic energy losses and the most probable escape distance, both governed by the numerical parameters of the power potential. It is found that these modifications for the kinetic-emission give considerably improved agreement between the theoretical and experimental universal reduced yield-energy curves. (auth)

34072 THE EFFECT OF NEUTRON IRRADIATION ON REMANENT MAGNETIZATION IN MULTIDOMAIN IRON AND KAMACITE. Butler, R. F.; Cox, A. V. (Stanford Univ., Calif. (USA)). J. Geomagnet. Geoelec.; 26: No. 1, 55-71(1974).

The effects of neutron irradiation on remanent magnetization in multidomain iron and kamacite (3 wt % Ni) samples of varying initial coercivities were investigated in order to determine whether cosmic ray exposure significantly affects the natural remanent magnetization (NMR) of lunar samples and chondritic meteorites. Irradiation to 10^{17} fast neutrons/cm^2 increased bulk coercive force (H_c) by an average of 15%. Annealing for 1 hour at 200-300°C returned H_c to its pre-irradiation value. The dominant effect of irradiation on remanent magnetization was to decrease the total intensity by 5-45%. AF demagnetization spectra of both isothermal and thermal remanence before and after irradiation indicate that neutron bombardment slightly increases the resistance to AF demagnetization. No similar increase in resistance to thermal demagnetization was indicated. The changes in H_c and AF demagnetization spectra are attributed to radiation induced point defects rather than to pinning of domain walls by vacancy clusters and dislocations. The NRM in chondritic meteorites and most lunar samples is too stable to be accounted for by exposure of isothermal remanence to cosmic rays. Thus the NRM must be some form of thermal or thermochemical remanence. (auth)

34073 TRANSIENT ANALYSIS OF SOLIDS SUBJECTED TO HIGH TEMPERATURE BY FINITE ELEMENT METHOD. Yagawa, G.; Ando, Y. (Tokyo Univ. (Japan). Faculty of Engineering). Nippon Genshiryoku Gakkaishi; 16: No. 8, 441-449(Aug 1974). (In Japanese).

A finite element method is presented, which deals with structures subjected to both high temperatures and neutron irradiation. The material effects discussed in this paper include the usual thermo-elastoplastic effects, thermal and irradiation-induced creep and swelling due to the fast neutron fluence. Heat conduction equations and equilibrium equations are derived by assuming a specific form of free energy together with the thermodynamic laws, von Mises yield criteria and the associated flow rule. To demonstrate the effectiveness of the present formulation, the transient creep analysis of a three-dimensional solid subjected to creep effect is presented. (auth)

34074 ACTIVATION ENERGY FOR CARBON DIFFUSION IN TUNGSTEN AND MOLYBDENUM. Shchelkonogov, V. Ya.; Aleksandrov, L. N.; Bukatov, A. V. Uch. Zap., Mord. Gos. Univ.; No. 76, 3-8(1972). (In Russian).

Calculations were made of the total activation energy for C diffusion in W and Mo taking into account various lattice distortions and interactions of the impurity with dislocations. Variations in the distances between dislocations of 80 to 800 Å and of the temperature of the appearance of the C peak in the internal-friction relaxation spectra were considered. Comparisons of these calculations with experimental data show that the activation energy for the diffusion of interstitial impurities from dislocations is in satisfactory agreement with activation energies for C diffusion in W and Mo derived from radiotracer and internal friction methods. (Referativnyi Zh.)

34075 EFFECTS OF RADIATION ON THE ABSORPTION AND LUMINESCENCE OF FIBER OPTIC WAVEGUIDES AND MATERIALS. Mattern, P. L.; Watkins, L. M.; Skoog, C. D.; Brandon, J. R.; Barsis, E. H. IEEE Trans. Nucl. Sci.; NS-21: No. 6, 81-95 (Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Irradiation of fiber optic waveguides with X-rays, gamma-rays, electrons, or neutrons can cause luminescence and losses in optical transmission. These effects were measured, using pulsed and continuous radiation sources, in bulk materials and in most commercially available fiber bundles. Some important effects of dopants and impurities such as Ge, Ti, Fe, Al, and OH on radiation-resistance were also determined. Transient absorption and luminescence were measured from 10 ns to 0.1s after irradiation (10 to 10^8 rads and 10^9 to 10^{13} rads/sec), and the permanent absorption was measured from 24 to 72 hours after irradiation (10^3 to 10^5 rads). These results show that synthetic vitreous silica (undoped), some doped silicas, polymethylmethacrylate and polystyrene can be used in radiation environments that are encountered in space and military applications. The utility of each of these fibers depends on the particular radiation environment, the length of waveguide, the wavelength of signal light, the time any system can be "off the air", and constraints imposed by fiber cost. The data can be used to determine the response of actual fiber systems during and after irradiation. (auth)

34076 X-RAY PRODUCED CHARGE DEPOSITION AND DOSE IN DIELECTRICS NEAR INTERFACES INCLUDING SPACE-CHARGE FIELD AND CONDUCTIVITY EFFECTS. Chadsey, W. L. (Science Applications, Inc., McLean, VA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 235-242(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

When a dielectric material is exposed to x- or γ-radiation, charge buildup occurs in regions of the dielectric near interfaces with dissimilar media. The charge buildup results from the divergence of photo-Compton current near the interface. The charge density acts as a source for an electric field. If one assumes a transient dielectric conductivity equal to the bulk radiation-induced conductivity of the dielectric, one can predict a sufficiently large x-ray generated space-charge field at high exposures to either limit the photo-Compton current—hence perturb the depth-dose profile in the dielectric—or initiate dielectric breakdown. There also occurs at the interface, however, a gradient in dose which should produce a gradient in transient conductivity. This conductivity gradient, it is shown, profoundly modifies the charge buildup and space-charge field in the dielectric. Calculations of current density, charge density, and space-charge field are presented for a planar gold/polyethylene interface irradiated by 30, 100, 200, and 1000 keV x-rays. It is found that for the lower x-ray energies the saturation space-charge field is too low to significantly perturb the depth-dose profile or initiate breakdown, but for the 1000 keV x-rays the saturation space-charge field may be sufficiently high to significantly perturb the depth-dose profile. In all cases, the charge density profile is strongly perturbed by the conduction currents, even for relatively low exposures. (auth)

34077 REPLACEMENT CURRENTS IN IRRADIATED MULTILAYER STRUCTURES. Singletary, L. D. (TRW System Group, Redondo Beach, CA); Nielsen, L. C.; Clement, D. M.; Wuller, C. E. Jr.; Fitzwilson, R. L. IEEE Trans. Nucl. Sci.; NS-21: No. 6, 291-294(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

An analytical method is described for calculating replacement currents in structures irradiated by x-ray photons, and the method is applied to the case of a structure consisting of plane parallel layers. The analysis consists of a computer-aided computation of photocurrent emission from the material layers; the photocurrents are then used as current generators in an equivalent circuit model, in which transient conductivity in air and dielectric layers is also incorporated. It is shown in particular that the presence of vacuum or air-filled void regions can have a large effect on the magnitude of the replacement currents. Calculated results are compared with experimental measurements for two specific test samples. (auth)

34078 LUMINESCENCE IN ELECTRON IRRADIATED CdS. Elsby, C. N. (Aerospace Research Labs., Wright-Patterson Air Force Base, OH). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 14-20 (Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Electron irradiation induced changes in both the photo- and cathodo-luminescence spectra of high purity CdS platelets were monitored over a wavelength range from 4800Å to 2 μm. The irradiations were all performed near 10K using beam energies from 100 keV to 1 MeV. By irradiating with electron energies between the cadmium and sulfur displacement thresholds, and above the cadmium displacement threshold, the damage induced lumines-

cence could be assigned to specific sublattices. The edge emission was found to decay in intensity when observed by photoluminescence but to increase in intensity when excited by 100 keV electrons following an irradiation above the sulfur displacement threshold. Broad band luminescence has also been produced by irradiation at 7200Å and 1.03 μm. The 7200Å band is not observed, however, until a thermal anneal is performed above a recovery stage centered at 180°K. The edge emission and bound exciton emission partially recover in this same temperature range. Another annealing stage is observed at 230°K by monitoring the intensity of emission bands at 1.03 and 1.65 μm. The annealing stage at 180°K is associated with sulfur sublattice damage recovery while the stage at 230°K is due to recovery of cadmium sublattice damage. (auth)

34079 PHOTOABSORPTION EFFECTS IN LOW TEMPERATURE ELECTRON-IRRADIATED GERMANIUM. Arimura, I. (Boeing Aerospace Co., Seattle). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 21-25(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Photoconductivity measurements performed under carefully controlled conditions have revealed that the dominant defects in low temperature, electron irradiated n-type Ge are optically active, double-acceptor type defects which thermally anneal at a temperature around 65°K. The stability of these defects is sensitive to temperature, background light levels, irradiation fluenced and fluxes, and probably impurity type and concentration. It is concluded from the results of this and other studies that the optically active defect is probably an isolated vacancy. (auth)

34080 CALCULATED DISPLACEMENT DAMAGE BY NEUTRONS IN InSb. Guenzer, C. S.; Manning, I. (Naval Research Lab., Washington, DC). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 26-29(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Displacement damage in InSb is calculated for 1 MeV and 14 MeV incident neutrons. Ranges and energy deposition profiles are calculated with the E-DEP-1 computer code and combined with published neutron cross sections to obtain atomic displacement rates and range distributions. The damage ratio of 14 MeV and 1 MeV neutrons is estimated as close to unity. Comparison results are presented for Si. Experimental verification for unity damage ratio is given. (auth)

34081 EFFECTS OF IRRADIATION ON THE ELECTRICAL AND OPTICAL PROPERTIES OF PbSnTe. Harper, H. T.; Green, B. A.; Leadon, R. E.; Naber, J. A. (Intelcom Rad Tech, San Diego, CA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 30-33(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Radiation effects on the electrical conductivity, Hall mobility, and carrier density were studied on three different types of p-type PbSnTe samples. One type (sample 1) was vapor-grown with an initial carrier density of $\sim 4 \times 10^{18}$ cm^{-3}, and was irradiated with 30-MeV electrons at 78°K. Another type (sample 2), which was cut from a solid-state recrystallized boule and then annealed to lower its carrier concentration to $\sim 8 \times 10^{17}$ cm^{-3}, was also irradiated with 30-MeV electrons at 78°K. The other type of specimen (sample 3) was an epitaxially deposited thin film on a BaF_2 substratum, with a carrier concentration of $\sim 4 \times 10^{17}$ cm^{-3}. It was electron-irradiated at 9°K and subsequently gamma- and neutron-irradiated at 78°K. Temperature dependence of the optical transmission for sample 3 was performed to determine the radiation dependence of the energy bandgap. For the low-carrier sample (1), electron fluence up to $\Phi = 6.5 \times 10^{18}$ e/cm^2 at 78°K produced increases in the conductivity and carrier density. Initially the Hall mobility increased, then decreased with fluences above $\Phi \simeq 2 \times 10^{18}$ e/cm^2. Sample 2 was electron-irradiated at 78°K to a maximum fluence of $\Phi = 2.45 \times 10^{18}$ e/cm^2. Both the conductivity and carrier density exhibited linear decreases with fluence, while the Hall mobility initially decreased slightly, but later increased. Sample 3 was electron-irradiated at ~9°K, where carrier removal similar to that in sample 2 was observed. The curve of carrier density versus temperature was quite flat below liquid-nitrogen temperatures. In preparation for a neutron irradiation, sample 3 was gamma-irradiated to levels expected during a neutron irradiation to see the effects of gamma irradiation only. No detectable change of the electrical or optical properties was observed. Subsequently, sample 3 was neutron-irradiated at 78°K. Neutron fluence dependence of the electrical parameters yielded linear decreases with fluence. A model is proposed that qualitatively explains the data of the temperature dependence of the carrier density and conductivity and on carrier removal or addition as a function of initial density. (auth)

34082 RADIATION EFFECTS ON THE SPECTRAL RESPONSE OF HgCdTe. Shepherd, F. D. Jr. (Air Force Cambridge Research Labs., Bedford, MA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 34-39(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

A theoretical model is presented for the effects of electron irradiation on the bulk electronic energy band parameters of HgCdTe. The material is treated as degenerate. The model predicts irradiation induced changes in the shape of spectral response and resolves apparent inconsistencies in the HgCdTe photoresponse data. Qualitative, overall changes in photoconductive detector response are predicted and a general trend is found that short wavelength materials are less susceptible to the effects of radiation. (auth)

34083 ELECTRON DAMAGE IN In_2Te_3: A DEFECT TETRAHEDRAL SEMICONDUCTOR. Swenson, H. (Aerospace Research Labs., Wright-Patterson Air Force Base, OH); Locker, D. R.; Meese, J. M.; Manthuruthil, J. C. IEEE Trans. Nucl. Sci.; NS-21: No. 6, 40-46(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Indium sesquitelluride (In_2Te_3) is typical of a large class of defect semiconductors which are tetrahedrally bonded but which possess room temperature vacancy concentrations of the order of 5.5×10^{21} cm^{-3}. It was proposed by V. M. Koshkin et al. that these semiconductors can not preserve non-equilibrium point defect concentrations. This hypothesis was tested in the present experiments by electron irradiating In_2Te_3 at 77°K with 1 MeV electrons and using electron paramagnetic resonance (EPR) to observe the results. Several different resonances were observed with g values ranging from 1.979 to 2.133 and possessing X-band line widths of 7 to 42 gauss. All of the resonances except the largest one at g = 2.019 have orientation dependent g values and all anneal at different temperatures suggesting that several different defect centers have been produced. Because the 1 MeV electron defect production rate for these centers at 77°K (0.01 to 0.1 defects/electron) is typical of defect production rates observed in other compound semiconductors, the hypothesis proposed by Koshkin et al. is incorrect. The stability of these defects is somewhat lower than in non-defect semiconducting compounds, however, since none of these defects survive prolonged room temperature annealing and since no additional complex centers formed by thermal annealing have been detected. (auth)

34084 EFFECTS OF STOICHIOMETRY ON THE RADIATION RESPONSE OF SiO_2. Sigel, G. H. Jr.; Friebele, E. J.; Ginther, R. J.; Griscom, D. L. (Naval Research Lab., Washington, DC). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 56-61(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Defect center production in irradiated silica is shown to exceed that found in stoichiometric SiO_2. The defect centers observed are the E′ type which are associated with oxygen vacancies. It is suggested that a large concentration of E′ centers is expected near the oxygen deficient Si-SiO_2 interface of irradiated MOS devices and that the presence of these defects is one source of positive space charge buildup within the first hundred Angstroms of the oxide. In addition, the 4500Å emission band observed in irradiated SiO_2 has been shown to be associated with the decay of E′ centers. (auth)

34085 EFFECTS OF ION BOMBARDMENT ON Na AND Cl MOTION IN SiO_2 THIN FILMS. Beezhold, W. (Sandia Labs., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 62-66 (Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

The effects of light and heavy ion bombardment on Na and Cl motion in SiO_2 : Si thin films were studied using proton-induced characteristic x-ray (PIX) and Rutherford backscattering (RBS) techniques. Results show that both Na and Cl atoms may be trapped in the oxides by implantation damage. Release does not occur under ionizing irradiation (proton bombardment). Partial release or motion does occur after annealing to 700°C or by further heavy ion bombardments. Na motion is consistent with the movement of single Na^+ ions in the oxide. In contrast, the movement of Cl atoms appears to be dominated by enhanced Cl diffusion or by motion of positive Cl-defect complexes whenever heavy ion bombardment damage is introduced. (auth)

34086 SODIUM MOBILITY IN IRRADIATED SiO_2. Fowkes, F. M.; Witherell, F. E. (Lehigh Univ., Bethlehem, PA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 67-72(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

The distribution of sodium in the oxide films of MOS capacitors was determined by etch-off procedures, using sodium-22 as a tracer. The effects on sodium distribution of ionizing radiation, of indiffused aluminum, and of bias-temperature stressing were

then determined and compared with C-V measurements of the total oxide charge in the same samples. Aluminum films sintered for 30 minutes at 500°C provided high aluminum concentrations (~10^{20}/cm^3) in the oxide near the surface, while sintering for 60 minutes caused aluminum to diffuse about three times deeper. In both cases low concentrations (~10^{18}/cm^3) were found next to the silicon. Aluminum-rich portions of the oxide were found to trap sodium, and thus the oxides with the 30-minute aluminum sinter had very little sodium concentrated near the silicon substrate (0.2 to 0.6 × 10^{11}/cm^2); the interfacial sodium accounted for only 2% of the oxide charge determined by C-V measurements. Oxides without aluminum or with 60-minute aluminum sinter had nearly 10-fold higher interfacial sodium concentrations (1 to 6 × 10^{11}/cm^2) and this interfacial sodium accounted for 10% of the oxide charge from C-V measurements. Ionizing radiation (10^6 rads in one hour from cobalt-60 at 25°C with a positive bias of 10^6 volts/cm) increased the total oxide charge by 14 to 17 × 10^{11} electronic charges/cm^2, but caused very small increases in interfacial sodium (0.2 to 0.9 × 10^{11} ions/cm^2). However, the combination of ionizing radiation followed by positive bias stress (10^6 volts/cm) at 300°C for 10 minutes caused an appreciable movement of sodium to the interface in some of the oxides, especially those with no aluminum or with aluminum sintered for 60 minutes. Positive bias at 300°C for 10 minutes in aluminum-doped oxides caused large increases in negative voltage shifts (corresponding to an increase of 10 to 20 × 10^{11} positive charges per cm^3) but in the same tests no more than 3 × 10^{11} sodium ions per cm^2 moved into the oxide next to the silicon substrate. These results suggest that the drift of positively charged aluminum interstitials may be the cause of much of the voltage shift in 300°C tests. (auth)

34087 CHARGE TRANSPORT STUDIES IN SiO_2: PROCESSING EFFECTS AND IMPLICATIONS FOR RADIATION HARDENING. Srour, J. R.; Curtis, O. L. Jr.; Chiu, K. Y. (Northrop Research and Tech. Center, Hawthorne, CA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 73-80(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Charge transport studies were performed on SiO_2 films using an electron-beam injection technique. MOS capacitors incorporating oxides grown at 1000 and 1100°C were investigated, including units fabricated at Hughes Aircraft using radiation hardening procedures. A comparison of beam-induced current vs field characteristics is made for devices with differing processing histories. Additionally, experimental determinations of trapped positive charge vs collected charge were performed. Present findings indicate that holes are mobile in SiO_2, that the schubweg model is insufficient for describing charge transport in SiO_2 films, and that the electron-hole pair creation energy for SiO_2 is ≲19 eV. Current vs field data can be qualitatively explained in terms of columnar and/or geminate recombination. Conclusions concerning the effects of processing on charge buildup are made and a qualitative model based on experimental findings is presented. Implications of this model for radiation hardening are discussed. (auth)

34088 CARRIER REMOVAL RATE IN NEUTRON-IRRADIATED SILICON. Goleminov, N. G.; Kramer-Ageev, E. A.; Mironov, Yu. A. (Moscow Inst. of Engineering Physics). Phys. Status Solidi (a); 28: No. 1, 371-377(16 Mar 1975).

The effect of neutron bombardment on the carrier removal rate in silicon is investigated using a model of a spherical cluster. As described by this model a somewhat lower carrier removal rate in n-type oxygen-containing silicon may be attributed to two dominating defects in the disordered regions, namely, divacancies and A-centers. The concentration changes in defects within a disordered region are analyzed and compared with those for isolated defects. The dependence of concentration on fast neutron fluence is discussed. The ratios of the initial carrier removal rate and the displacement rate are shown to be independent of primary recoil energy in the 2 to 200 keV energy interval. (auth)

34089 EFFECT OF REMOVAL OF GALLIUM ACCEPTORS IN ION BOMBARDED SILICON. Igras, E.; Krylow, J.; Rosinski, W. (Inst. of Electron Tech., Warsaw). Phys. Status Solidi (a); 28: No. 1, 321-325(16 Mar 1975).

Using mirror electron microscopy it has been found that the concentration of gallium atoms acting as acceptors in silicon, drops in the course of bombardment of the sample with energetic ions. In the case of samples doped with gallium, a conversion of conductivity type and p–n junction formation is observed. The effect is explained in terms of a variation of the lattice sites of gallium in the course of ion bombardment. A gallium atom in an interstitial lattice site in silicon does not act as acceptor. After a sufficient dose of bombarding ions, all gallium acceptors can be removed. The effect is reversible: annealing at temperatures above 150°C recovers the acceptor concentration. (auth)

34090 PROBLEM OF DETERMINING THE IONIC COMPONENT OF THE TOTAL ELECTRICAL CONDUCTIVITY OF NONSTOICHIOMETRIC COMPOUNDS. Pavlov, Yu. A.; Polyakov, V. P.; Ploshkin, V. V. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 11, 9-13(1974). (In Russian).

By methods of mathematical statistics it is shown that the partial pressure of oxygen and temperature have an effect on the value of the ionic component. Consideration is devoted to processes taking place in a galvanic cell having a separated, gas space, where values of the ionic component of the total electrical conductivity were determined. (tr-SJR)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

34091 (LA-5904-MS) MEASUREMENT OF TRANSURANIC SOLID WASTES AT THE 10-nCi/g ACTIVITY LEVEL. Umbarger, C. J.; Cowder, L. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1975. Contract W-7405-ENG-36. 12p. Dep. NTIS $4.00.

The measurement of transuranic contaminated solid wastes at 10-nCi/g activity levels is presented, including a variety of different approaches to the problem. The development of two nondestructive assay systems, the MEGAS and the Pancake Counter, is described in detail. These are NaI-based detection systems to be used specifically for low-density solid transuranic wastes. They are of value in effective implementation of new federal regulations pertaining to transuranic waste management in that they supplement the usual administrative decision making in waste handling. (auth)

34092 (NMC-008) STUDIES ON THE NUCLEAR-MATTER MANAGEMENT SYSTEM. (Nuclear Material Control Center, Tokyo (Japan)). Mar 1973. 80p. (In Japanese). NTIS (U. S. Sales Only).

As an entrusted work in the peaceful uses of atomic energy, Nuclear Material Control Center undertook the study on the nuclear-matter management system in 1972. Of the four groups in the nuclear-matter Management System Committee organized for the purpose, the "system group" studied (1) the development of statistical methods for evaluation of the nuclear-matter flow (including the data generators); and (2) the origins of MUF (material unaccounted for). The results of studies by the system group are described. The purpose is to establish the same system in Japan, and also to make for safeguards inspection by IAEA. (JA)

34093 SAFEGUARDS FOR FISSILE MATERIALS. I. General Aspects. Harry, R. J. S. Atoomenergie Haar Toepass.; 17: No. 2, 36-42(Feb 1975). (In Dutch).

The main provisions of the U. N. treaty on non-proliferation of nuclear weapons are outlined. Administrative problems of its implementation at the international level, as well as related problems of internal safeguards to prevent illegal, or irresponsible use of fissile materials are discussed. Technical problems of detecting clandestine fissile stockpiles, test explosions, etc. will be discussed in a subsequent article. (NL)

34094 NUCLEAR MATERIALS: ACCOUNTABILITY, MANAGEMENT SAFEGUARDS. Lovett, J. E. Hinsdale, IL; American Nuclear Society (1974). 308p.

The philosophy and practices of nuclear materials control are presented. Examples of good and bad materials control are drawn from the author's observations of facility practices throughout the U. S. nuclear community. This book will be a most useful guide and reference source in the field where the work goes on and in the manager's office where plans and decisions are authorized. It will help in designing an optimum system for a specific management situation. Around this text instruction courses can be structured for training the technical personnel needed now in the rapidly expanding nuclear industry. (auth)

Disposal and Storage

Refer also to abstracts 32655, 32659, 33034, 33096, 34113, 34962, and 35647.

34095 (BNWL-1899) NUCLEAR WASTE MANAGEMENT AND TRANSPORTATION. Quarterly Progress Report, October–December 1974. Dau, G. J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1975. Contract AT(45-1)-1830. 70p. Dep. NTIS $5.45.

Research progress is reported on all Division of Waste Management and Transportation funded programs at Battelle, Pacific Northwest Laboratories, with the exception of the Commercial Radioactive Waste Fixation Program. Topics reported on include advanced methods for management and disposal of radioactive wastes; separation of actinide elements from radioactive waste; decontamination and densification of chop-leach cladding residues; pyrolysis-incineration of combustible alpha wastes; tritium separation and fixation; characteristics of 300 and WYE burial grounds; disposition of retired contaminated facilities at Hanford; development of packaging technology for $Pu(NO_3)_4$ shipment; and transportation safety studies. (TFD)

34096 (CONF-750424-1) MANAGEMENT OF WASTES FROM THE NUCLEAR FUEL CYCLE. Blomeke, J. O. (Oak Ridge National Lab., Tenn. (USA)). 1975. 24p. Dep. NTIS $4.25.

From American Nuclear Society meeting on commercial nuclear fuel technology today; Toronto, Ontario, Canada (27 Apr 1975).

It is clear that a wide spectrum of work remains to be accomplished if we are to be ready with proven technology to handle the increasing quantities of fuel cycle wastes that will be generated in the relatively near future. The wastes and the requirements for their management have been reasonably well characterized, however, and experimental programs leading to responsible, acceptable solutions are under way. In almost every instance, the principal work remaining consists of engineering and hot pilot-plant demonstrations of techniques and processes that have been reasonably well developed on a laboratory scale. This is usually the most expensive phase of developing any new process, and is often the most difficult to accomplish. It is most essential that this work be carried to completion as scheduled within the next 3 to 5 y if we are to have methods ready for industrial application when they are needed for public acceptance of nuclear power. (auth)

34097 (ORNL-4962) DEVELOPMENT OF CEMENTITIOUS GROUTS FOR THE INCORPORATION OF RADIOACTIVE WASTES. Part I. Leach Studies. Moore, J. G.; Godbee, H. W.; Kibbey, A. H.; Joy, D. S. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 116p. Dep. NTIS $5.45.

The grouts used in the Hydrofracture Facility at Oak Ridge National Laboratory (ORNL) are made by blending ORNL intermediate-level radioactive waste solution with a dry mixture of cementitious materials and selected clays. Results of laboratory leach studies made with simulated grouts containing ^{85}Sr, ^{137}Cs, ^{239}Pu, or ^{244}Cm in order to determine how effectively the grouts would retain radionuclides in the unlikely event that they were to come in contact with water are presented. (TFD)

34098 (SAND-75-0162) DEEP ROCK DISPOSAL EXPERIMENT NO. 1: ACOUSTIC STUDIES. Beattie, A. G. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1975. Contract AT(29-1)-789. 38p. Dep. NTIS $5.00.

A series of acoustic studies were conducted as a part of the Deep Rock Disposal Experiment No. 1 (DRD-1). These studies included ultrasonic and acoustic emission experiments. The acoustic emission experiments included both continuous monitoring and source location. The thermal design of DRD-1 subjected the acoustic transducers to temperatures in excess of 600°C near the end of the experiment. This temperature required the use of $LiNbO_4$ transducers and the development of new transducer bonding techniques. After an initial shakedown period the acoustic experiments proved, in general, to be successful. While this shakedown period prevented the acquisition of a complete set of acoustic data, the data which was obtained proved the value of the acoustic experiments and supports their inclusion in future DRD-1 type experiments. The experiments did show the need for some changes in the experimental apparatus but these modifications are understood and can be implemented without great difficulty. (auth)

34099 PROCEDURE AND EQUIPMENT FOR THE PACKAGING OF SOLID WASTES, PARTICULARLY RADIOACTIVE WASTES. Herzog, J. (to Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Grossauheim (F. R. Germany)). German(FRG) Patent 2,243,136/A/. 14 Mar 1974. 5p. (In German).

In the method on which the discovery is based, the packaging of radioactive or also toxic waste materials is directly carried out in the drum under air exhaust. This is achieved by compression in a safety tube with a suction device which can be led air-tight over an elevating mechanism into a drum. The whole equipment is placed in a low-pressure chamber to prevent contamination. (GE)

Handling Equipment and Procedures

Refer also to abstract 34778.

34100 (ARH-468(Rev.2)) TECHNICAL CRITERIA FOR THE PREVENTION OF CRITICALITY. Shaw, H. P. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Feb 1975. Contract AT(45-1)-2130. 12p. Dep. NTIS $4.00.

Atlantic Richfield Hanford Company (ARHCO) Policy Guide 1.6.6, "Criticality Prevention," and Operating Instruction 1.6.6.2, "Criticality Prevention in Process Facilities," present the policy of the Company with respect to the control of criticality hazards, and delegate the responsibility of specifying safe limits for the

design and operation of process facilities to the Manager, Research and Engineering Division. The purpose of this document is to define the technical criteria to be used in developing the limits within which ARHCO facilities are to be designed and operated. These criteria are based on the operating experience accumulated from the processing of fissile materials since the year 1944. (auth)

34101 (NTO-A-0030(Sec. 049)(Rev. 1)) ETS-1 AREA CONTROL FOR A NON-RUN FUELED TEST ARTICLE CONFIGURATION. Revision 1. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 4 Feb 1969. 4p. Dep. NTIS $4.00.

The area controls at ETS-1 for non-test periods when a nuclear fueled test article is installed or enroute to the Test Stand are specified, and the responsibilities of Test Stand personnel are described. (LCL)

34102 (WANL-TMI-981) HANDLING OF RADIOACTIVE BY-PRODUCT MATERIAL IN MATERIALS IRRADIATION TEST LABORATORY, BUILDING 9. Vogel, M. A. (Westinghouse Elec. Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 20 Feb 1964. 4p. Dep. NTIS $4.00.

The overall sequence of and proposed procedures for handling material from irradiation experiments, i.e., mixed fission products generated in enriched NERVA fuel material and activation products generated in experimental hardware, are presented. (LCL)

Transportation

Refer also to abstracts 34131, 35176, and 35177.

34103 (DPSPU-74-124-3) SAFETY ANALYSIS REPORT: PACKAGES. LP-12-1 Tritium Package (Packaging of Fissile and Other Radioactive Materials). Final Report. Edl, J. W. (comp.). (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Plant). Jan 1975. Contract AT(07-2)-1. 73p. Dep. NTIS $6.75.

Elemental tritium is shipped from the Savannah River Plant in a 1-liter stainless steel vessel (LP-12-1) sealed within an aluminum vessel and surrounded by 3.9 in. thick Celotex insulation in a steel drum. The package is shown to comply with regulatory requirements for normal transport and hypothetical accident conditions. (TFD)

34104 (ORNL-TM-1312(Vol.16)) OBSOLETE CASK PROGRAM: TEST NUMBER 2. Shappert, L. B.; Bradley, N. C.; Evans, J. H.; Jurgensen, M. C. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 23p. Dep. NTIS $4.00.

The Obsolete Cask Program was initiated to study the behavior of large casks under specified destructive test conditions and to establish the adequacy of the calculational techniques that are presently employed to predict cask damage. A cask was subjected to impact tests, which involved 30-ft drops onto a solid, essentially unyielding surface. The cask, which weighed 7100 lb, was dropped on end. Deformation of the cask and accelerations at several points were predicted before the tests; these predicted values were compared with the test results obtained from an extensive instrumentation system. Both predicted cask deformations and accelerations agreed reasonably well with the measured values. (auth)

34105 (WANL-TMI-550) NRX SPENT FUEL SHIPPING CASK. Ricks, L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Mar 1963. 3p. Dep. NTIS $4.00.

An analysis was made to determine the lead thickness required to provide adequate shielding for 200 NRX spent fuel elements and the resulting radiation heating rates in the container. (auth)

34106 (WANL-TMI-1955) PLASTIC SHIPPING BOTTLE QUALIFICATION TEST. Anderson, R. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Jan 1969. 9p. Dep. NTIS $4.00.

Tests were conducted at ambient conditions to evaluate the structural soundness of the "welded" seam of a plastic bottle used for shipping enriched powdered graphite. The vibration test consisted of a sweep from 5 cps to 26 cps at an input level of 1.3 g's and from 26 cps to 52 cps at a double amplitude of .036". A resonance was noted at 8.2 cps. A resonance dwell test of 30 minutes duration was conducted at 8.2 cps at an input level of 1.3 g's. An inspection after the horizontal direction vibration test revealed a failed stand-off in the shipping container. It was also noted that the packaging material had been compacted considerably and that graphite powder had worked out of the plastic bottle. Another ICC-6L Shipping Container was used to replace the failed one for the vertical vibration test. The vertical direction test consisted of a sweep through the same frequency range and input levels as the horizontal direction vibration test. The resonance dwell however was conducted at 9.8 cps at a 1.3 g's input level. No damage occurred to the bottle or container. For a static test, the plastic bottle was suspended by a stainless steel strap around the threaded portion of the bottle. The bottle was then filled slowly with lead shot until a total weight of 50 pounds was reached. An inspection did not reveal any damage to the bottle or the "welded" seam. (auth)

34107 (WASH-1339) SHIPMENT OF NUCLEAR FUEL AND WASTE: ARE THEY REALLY SAFE. (USAEC Division of Waste Management and Transportation, Washington, D. C.). Aug 1974. 12p. Dep. NTIS $4.00.

A general review of radioactive materials transport and the safety aspects of various transportation modes are presented. (TFD)

34108 CELOTEX: INSULATED SHIPPING CONTAINERS. Lewallen, E. E. (E. I. du Pont de Nemours and Co., Aiken, SC). Int. J. Radiat. Eng.; 1: No. 3, 249-264(Sep 1971).

From 3rd international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

Seven different kinds of packages for shipping radioactive materials were developed at Savannah River Plant using "Celotex" for thermal and shock protection. Twenty packages were dropped 30 ft at least once and eight packages were furnace tested at 1475°F. Military Standard drums were specified for all packages because of stronger construction and closer tolerances. Clearances between the "Celotex," the drum, and the inner container were minimized. Criteria for locking-ring tightness were established. The maximum allowable weight of a package with a 16-gage, 55-gal drum was estimated to be about 600 lb. Since "Celotex" is combustible and evolves gases when heated, drums were vented to avoid rupture in the furnace test. To prevent smoldering of "Celotex" after removal from the fire, refractory insulation material was placed adjacent to the vent holes to retard air flow into the drum. Samples of "Celotex" were heated at 250, 300, and 350°F for 14 days. Compressive stress tests of the samples showed minimal effect on those that had been heated at 250°F. Above 280 to 290°F, significant mechanical degradation occurs. "Celotex" smolders at 400°F and burns rapidly at 425°F. Results showed that "Celotex" may be used successfully as an insulation material to comply with regulations for Type B packages. (auth)

34109 THERMAL SHIELDS FOR SHIELDED CONTAINERS FOR RADIOACTIVE MATERIALS. Dixon, F. E. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Int. J. Radiat. Eng.; 1: No. 3, 265-272(Sep 1971).

From conference on lead shielding and nuclear safety; London, Eng. (25 Mar 1969).

Experimental work carried out at AERE Harwell has been aimed at the application of a number of materials to providing thermal protection for bare lead and steel clad lead containers, under the conditions of the IAEA test which follows the 30 ft. drop test. Various solutions have been produced, including materials such as wood, cane fiber ("Celotex"), chipboard, vermiculite, boron loaded resins, resin bonded cork and steel. The different solutions are characterized by different applications (according to criteria of expendability of the shield and packaging, of size, and of type of packaging). Test models and test results as well as the various uses of these shields are described. (auth)

34110 RECENT DEVELOPMENTS IN LEAD SHIELDS FOR TRANSPORT CONTAINERS IN THE UNITED KINGDOM. Smith, R. (Lead Development Association, London). Int. J. Radiat. Eng.; 1: No. 3, 273-288(Sep 1971).

From 3rd international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

The manufacture of the earliest transport containers in the U. K. suffered from lack of liaison between the various interests involved and the absence of any really satisfactory regulations and testing procedures sometimes had unfortunate results. The introduction of regulations for safe transport tended to make for improved liaison but at the same time brought new problems. While the UKAEA solved the direct problems associated with the new regulations the lead industry was busy developing new techniques of shield manufacture. The use of simple cast shields was gradually being replaced by shields fabricated from rolled lead sheet and slab. Further increases in the size and activity of sources being carried introduced new problems in that the conduction of "source heat" through this type of shield was not very efficient and further development became necessary resulting ultimately in the production of shields made up from a

number of smaller cast units thus taking advantage of the best features of both techniques. The cast units provide an efficient transfer of source heat to the outer steel where it is dissipated while the fabrication technique simplifies manufacture and handling problems. The introduction of this combination technique coincided conveniently with the introduction of the "heat sink" theory by UKAEA eliminating the need for external packaging on the largest containers. Liaison throughout has now been improved so that designs facilitate the use of the most efficient techniques. Regulations and testing have thus become matters of guidance rather than restriction. Production efficiency is now such that the rigorous testing currently applied is almost unnecessary and is seen in the light of testing for approval rather than for rejection. (auth)

34111 LEAD REMELT EXPERIENCE WITH 60-TON CASK. Lusk, E. C. (Battelle Columbus Labs., Ohio). Int. J. Radiat. Eng.; 1: No. 3, 289-298(Sep 1971).

From 3rd international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

The fabrication of large-size spent fuel shipping containers can result in a variety of unanticipated crises. During the fabrication cycle of the NFS-100 cask (a 60-ton gross weight cask), there was a failure of the lead pouring equipment which necessitated the remelting of 80,000 lb of lead. Since the "lead pour" phase is near the end of a cask fabrication cycle, it was necessary to quickly establish a guaranteed success remelt operation which would result in a nonporous gamma shield. The size of this particular cask and a large number of heat rejection fins necessitated the set up of shroud-type furnace within the metal fabrication shop which would bring the entire cask up to the desired lead remelt temperature of approximately 680°F. Five 750,000 BTU rated liquid propane burners (oriented so the flame was directed tangential to the cask finned exterior) were positioned at several vertical levels and a successful remelt operation was carried out. This paper presents the details of that operation, as well as the temperature history of the cask. Temperatures were recorded by means of both external thermocouples welded to the cask and dip-type thermocouples employed within the lead volume to establish the liquid/solids interface and its movement with time. The remelt operation required 27 h to complete, was completed on site, and resulted in a void-free gamma shield. Specifics of this operation and associated temperature data are detailed. (auth)

34112 QUALITY CONTROL OF SHIPPING CASK FABRICATION. Short, A. (Div. of Automation Industries, Inc., Richland, WA). Int. J. Radiat. Eng.; 1: No. 3, 299-320(Sep 1971).

From 3rd international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

Vitro Engineering redesigned and inspected the modification of a cask (HAPO-1C-1) for shipping cesium-137. Safety requirements involving structural and containment integrity were understandably high. To achieve this conformance to stringent safety criteria, a carefully devised and administered quality-control program was prepared and implemented. Because of the complex structural configuration of the cask, a detailed fabrication plan was prepared to insure that each component was correctly installed in the proper sequence. This fabrication plan provided the framework for the ensuing quality-control program. Every requirement for conformance to doses, specifications, and drawings was carefully listed for each step in the preparation of every component and for the subsequent assembly of components to complete the fabrication. Thus, a "control" document evolved that was completely comprehensive and chronological in arrangement. An adequate force of carefully instructed and experienced inspectors maintained constant surveillance over every facet of fabrication and assembly. (auth)

34113 SHIELDED TRANSPORT CONTAINERS FOR INTERMEDIATE AND HIGH-LEVEL RADIOACTIVE WASTES. Bechthold, W.; Heil, J.; Schuchardt, M. C.; Wolf, R. (Gesellschaft fuer Kernforschung m. b. H., Karlsruhe, Ger.). Int. J. Radiat. Eng.; 1: No. 3, 239-248(Sep 1971).

From 3rd international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

The shipment of radioactive wastes from the Karlsruhe Nuclear Research Center to the point of final storage in the ASSE salt mine is reviewed. In accordance with the p. a. transport system, drums with low-level wastes are carried without any additional shielding. Most of the intermediate level wastes are shipped in a bulk container with variable shielding capable of accomodating seven 2001 drums and weighing between 24.5 and 35 tons, depending upon the required shielding. Because of the limited load carrying capacity of the hoisting equipment of the mine, the drums filled with the waste are moved below ground individually in shielded discharge containers. No shielded room is required for changing the drums from the bulk container into the single container. Heat generating high-level wastes from reprocessing plants are vitrified and enclosed in steel molds. A study on the optimization of the shipment of these molds indicated that shipment in single containers is the most advantageous way on account of the small quantities of waste to be shipped from Karlsruhe to the ASSE mine in the next few years. These single containers have a steel shielding of 37 cm thickness and a finned surface for dissipation of the afterheat from the fission products. For loading and unloading, the container has a gripping device to pull the glass cylinders into the container and lower them into holes in the mine. This requires no additional shielding. (auth)

34114 PARTICULAR SOLUTION TO MEET REGULATIONS REQUIREMENTS. Redon, A.; Sousselier, Y. (CEA, Chatillon, France). Int. J. Radiat. Eng.; 1: No. 3, 217-238(Sep 1971).

From 3rd international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

Casks which were originally designed for in-site "transfer" purposes of radioactive materials did not fully comply with the transportation regulations. Basically these regulations introduce more drastic requirements as far as containment, heat transfer, and resistance to accident conditions are concerned. Examples of solutions adopted in France to improve such "transfer" casks, in order to use them as "transport" casks, are described, based upon the principle of segregation of the packaging functions. This is solved essentially by building special "transport" shells which mainly ensure the resistance to accident conditions (impacts and fire). (auth)

34115 1970 REVIEW OF THE IAEA REGULATIONS FOR THE SAFE TRANSPORT OF RADIOACTIVE MATERIALS. Swindell, G. E. (Waste Management International Atomic Energy Agency, Vienna). Int. J. Radiat. Eng.; 1: No. 4, 321-329(Oct 1971).

From 3rd international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

A brief review is given of the historical development of the IAEA Regulations for the Safe Transport of Radioactive Materials together with a summary of the extent to which they are known to have been adopted by Member States and international transport organizations. A detailed description is given of the procedures for convening an international panel of experts in 1970 to review the regulations as a whole and the working methods adopted. The main changes proposed by the panel at its first meeting are outlined. The comments of Member States on these changes will be considered by the panel at its second meeting in 1971. Reference is made to other recent work of the Agency including the organizing of a seminar on the test requirements for packaging for the transport of radioactive materials. (auth)

34116 GUIDE TO THE U. S. TRANSPORTATION REGULATIONS. Cornish, A. C.; Simens, H. G. (Dept. of Public Health, Berkeley, CA). Int. J. Radiat. Eng.; 1: No. 4, 331-348(Oct 1971).

From 3rd international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

The brochure "Shipping Radioactive Materials" has been published by the Bechtel Corporation with the objective of simplifying the U. S. Department of Transportation regulations for the shipment of radioactive materials. It has an action sequence format and uses flow charts whenever possible. The action sequence follows the normal progression one goes through in establishing whether the rules apply to him and what he must do to follow them. The greatest attempt was made to condense, paraphrase, abbreviate, and bring together at one place all pertinent information on each topic in the regulations. (auth)

34117 COMPACT METALLIC IMPACT LIMITERS FOR SHIPPING CONTAINERS. Burian, R. J.; Lusk, E. C. (Battelle Columbus Labs., Ohio). Int. J. Radiat. Eng.; 1: No. 4, 349-364 (Oct 1971).

From 3rd international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

Two types of all-metal impact limiters have been developed to protect radioactive shipping containers from damage due to accident conditions such as those outlined in the AEC 10-CFR-Part 71 Regulations. One type is designed to protect the shipping container from blows directly on the end or on an edge at the critical oblique angle. This type of impact limiter is comprised of a cluster of metal tubes or a welded metallic honeycomb within a specific array. The kinetic energy of the container is absorbed by plastic strain of the tubes or honeycomb structure, which in turn protects the cask from deformation and excessive forces which could damage the container or its contents. This

type of impact structure is fully enclosed in a metallic shell (normally stainless steel) for corrosion reasons and easing decontamination. The development of the design is detailed below and the mechanics of applying the design equations are also illustrated. The second type of limiter is designed to protect the shipping container from impact on the side. This design incorporates metallic tubes, partially filled with water, attached to the surface of the shipping container so that the tube axis is parallel to the container axis. Upon impact the tubes are deformed causing the pressure in the tubes to increase. At a pre-designed pressure, relief ports open and the water is expelled through orifices. The kinetic energy of the cask is absorbed not only by plastic deformation of the tube but also by the inertia and viscous losses in the water as it is expelled. The water also serves as a neutron moderator for containers which are used to ship neutron emitting materials. (auth)

34118 AIR CUSHION SUPPORT FOR HIGHWAY TRANSPORT OF HEAVY LOADS. Trask, W. H. (Riggers Manufacturing Co., Kennewick, WA). Int. J. Radiat. Eng.; 1: No. 4, 365-373(Oct 1971).

From 3rd international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

Air cushion technology is defined and related to applications in highway hauling. Equipment design requirements are discussed. Load spreading as a highway "preserving" technique is introduced with consideration for bridge capacities. The technology and economics of cushion support applied to spent fuel hauling are briefly considered. The possible effects of cushion vehicles on highway regulations are predicted. And, finally, the role of highway commissions in developing cushion support technology is suggested. (auth)

34119 RADIATION SURVEY OF THE TRANSPORTATION OF RADIOACTIVE MATERIALS. Schmidt, G. D. (Bureau of Radiological Health, Rockville, MD). Int. J. Radiat. Eng.; 1: No. 4, 375-385(Oct 1971).

From 3rd international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

The current standards for the maximum allowable radiation from packages of radioactive material in transportation were published by the Interstate Commerce Commission in 1947. The surface dose rate limitation of 200 mrem/h was designed to prevent transportation workers from receiving more than 100 mrem per day during package handling, while the limit of 10 mrem/h at 3 ft was based upon considerations of exposure to photographic film. Although there has been an excellent record of safety in transporting radioactive materials there is little data available in the literature regarding radiation exposure of transportation workers and the general public or the degree of compliance of radioactive material shipments with the transport regulations. Based upon these considerations the Atomic Energy Commission, Department of Transportation, and Department of Health, Education, and Welfare undertook a joint project to study the matter in greater depth. The survey conducted at 6 geographical locations (and 23 transportation terminals), included a radiation survey of about 300 packages (primarily radiopharmaceuticals). The results of the survey include (1) data on radiation levels from radioactive material packages, (2) an evaluation of radiation exposure to transportation workers, and (3) information on compliance by carriers and shippers with the transport regulations, including, labeling, transport index (TI) and separation distances. It was the conclusion of the survey that the radiation exposure of transportation workers under the conditions observed were within permissable limits. A possible exception was noted in the case of radium shipments which involved only 8.2% of the packages surveyed but represented 56% of the total exposure rate at 3 ft and 39% of the total surface exposure rate. The acceptability of radiation exposure of individuals resulted from the short transit times of packages and the low exposure rates external to the package, rather than carrier compliance with stowage/separation distance requirements. (auth)

34120 AEC ACCIDENT RECORD AND RECENT CHANGES IN AEC MANUAL CHAPTER 0529. McCluggage, W. C. (Atomic Energy Commission, Washington, DC). Int. J. Radiat. Eng.; 1: No. 4, 387-398(Oct 1971).

From 3rd international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

Accidents within AEC operations during the period 1949 through 1970 involving radioactive materials are reviewed and presented in tabular form. Changes in AEC Manual Chapter 0529, "Safety Standards for the Packaging of Radioactive and Fissile Materials", since its issuance in 1964 are reviewed. (TFD)

34121 PREVENTING SHIPPING INCIDENTS: TWO CASE STUDIES. Becker, R. C. (Univ. of California, Livermore). Int. J. Radiat. Eng.; 1: No. 4, 399-406(Oct 1971).

From 3rd international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

Two minor problems in the shipment of radioactive materials led to improved administrative controls at Lawrence Livermore Laboratory, Livermore, California. A plutonium-238 source was found by one recipient within its shipping container but not within a protective inner container. A defective holddown mechanism in another instance allowed an iridium-192 source to shift position within the container from fully shielded to partially shielded. No similar problems have occurred in the past two years. (auth)

34122 OPERATING EXPERIENCE IN THE SHIPMENT OF RADIOACTIVE MATERIALS. Iya, V. K.; Deshpande, R. G.; Kulrarni, M. D. (Bhabha Atomic Research Centre, Trombay, India). Int. J. Radiat. Eng.; 1: No. 4, 407-416(Oct 1971).

From 3rd international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

Indian experience in the shipment of radioactive material and the carrier problems encountered are described. The Isotope Division of the Bhabha Atomic Research Centre, Bombay, India is responsible for the shipment of all radioactive isotopes and radiation equipment. During the past twelve years, over 100,000 consignments of various radioisotopes have been shipped within India and also to many countries all over the world. The range of radioisotopes shipped vary from the very short-lived to the long-lived and from microcurie quantities to kilocurie quantities. Factors such as physical and chemical form of the radioactive material have a direct bearing on the design of the package. In addition, the mode of transport, shipping distance and transit time have also to be considered. Within the country, shipments of radioactive material are made by passenger aircrafts, passenger trains and road transport. Overseas shipments are made by passenger aircrafts and cargo ships. Problems encountered in persuading carriers to carry radioisotope shipments are described. The paper describes both light and heavy packages used in transport of radioisotopes. The design of the package takes into account the shipping distance and the transit time since shipping distances in India are as large as 2000 km. and the transit time is often 72 h or more. Significantly higher quantities of radioactive material have to be dispensed and this necessitates using heavy packages. A few accidents involving radioisotope packages are described. (auth)

34123 TRANSPORTATION AND HANDLING OF RADIOACTIVE PHARMACEUTICALS AND RADIOACTIVE CHEMICALS. Sanger, S. H. (Cabs Unlimited, Inc., Mountainview, CA). Int. J. Radiat. Eng.; 1: No. 4, 417-422(Oct 1971).

From 3rd international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

The movement of Radioactive Pharmaceuticals and Radioactive Chemicals, either by surface or air or a combination thereof, has been a monumental problem from the inception of the original processing of nuclides due to the short half-life of the commodity. Many precautionary measures must be taken to insure a safe and timely delivery of these radioactive products. From the moment the nuclide has been processed, the problem of packaging and transporting, coupled with the services needed to insure fast portal to portal delivery, is extensive. Both the surface carrier and the air carrier must handle this material with precision-like speed. Packaging, handling, shipping and transporting are an integral factor in connection with the supply of this product. (auth)

34124 RECENT DEVELOPMENTS IN NONDESTRUCTIVE EVALUATION APPLICABLE TO ENCAPSULATED ISOTOPES. Newman, D. R.; Crowe, J. C. (Battelle Pacific Northwest Labs., Richland, WA). Int. J. Radiat. Eng.; 1: No. 5, 493-516(Nov 1971).

From third international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

Nondestructive evaluation (NDE) techniques have been applied recently at Battelle-Northwest to primary containers and capsules of radioisotopes to ensure the highest possible integrity of these containers. New techniques have been developed in the ultrasonic and acoustic emission areas. These techniques, along with a philosophy of bringing the NDE personnel into the design of the container before the design is finalized so he can suggest how to make the design "testable," have proven to be an important asset in maintaining container integrity. (auth)

34125 ATMX-600 RAILCAR. A New Concept in Radioactive Waste Shipments. Adcock, F. E. (Dow Chemical Co., Golden, CO). Int. J. Radiat. Eng.; 1: No. 5, 425-436(Nov 1971).

From third international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

The Dow Chemical Company, Rocky Flats Division has been shipping plutonium-contaminated waste to Arco, Idaho, in unique railroad cars known as the ATMX-600. Six cars have been in service since April, 1969. All operating experience has been favorable. ATMX-600 cars have removable roof sections to permit loading the 15-m long cargo area. Useful load is 46,000-kg; maximum gross weight is 100,000-kg. Waste is packaged in plywood crates or steel drums. These in turn are stowed in 6-m ISO steel cargo containers to permit rapid loading of the railcar. No radiation protection or heat removal provisions are necessary for this type of non-irradiated waste. An engineering evaluation shows that the railroad transportation environment is favorable, the relative hazard potential of waste shipments is low, and that the ATMX car's performance meets the requirements for Type B packaging. (auth)

34126 ATMX-500 RAILROAD CAR RADIOACTIVE WASTE CONTAINER. McDonald, E. P. (Monsanto Research Corp., Miamisburg, OH). Int. J. Radiat. Eng.; 1: No. 5, 437-452(Nov 1971).

From third international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

The development of a radioactive waste container concept, the modifications necessary to achieve a suitable container, and Mound Laboratory's experience in using this container are outlined. The modified ATMX-500 railroad car has been certified as meeting all applicable AEC and DOT requirements and is currently being used under DOT Special Permit No. 5948. (auth)

34127 SHOCK AND VIBRATION MEASUREMENTS DURING NORMAL RAIL AND TRUCK TRANSPORT. Foley, J. T.; Gens, M. B. (Sandia Labs., Albuquerque, NM). Int. J. Radiat. Eng.; 1: No. 5, 453-474(Nov 1971).

From third international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

At the suggestion of Division of Construction, Headquarters AEC, the Union Carbide Corporation invited the Environmental Criteria Group of Sandia Laboratories to participate in a transportation test involving the transportation of a radioactive materials (RAM) cask from Paducah, Kentucky, to Oak Ridge, Tennessee, by railroad and the return to Paducah by truck. Sandia instrumented the vehicles and measured the shock and vibration inputs to the RAM cask. This paper reviews the conduct of the Sandia data experiments, describes the instrumentation, discusses the data reduction techniques used, and presents the resulting data in summary form. The summarized data provides a comparison of the intensity of the shock and vibration encountered in the rail and truck transport environments. The main purpose of the Sandia participation was to obtain data to be used in applied research pointed towards developing descriptions of environmental inputs to cargo, and more specifically the following points: (1) to develop a more complete description of the rail transport dynamic environment than had theretofore been available; (2) to develop a description of in-transit rail transport shock as opposed to switching yard shock; (3) to provide additional information on the truck environment to supplement the results of prior work; and (4) to provide a means of comparison between environmental levels within the two modes of transport. (auth)

34128 HOW ABNORMAL IS NORMAL? Sisler, J. A. (Atomic Energy Commission, Washington, DC). Int. J. Radiat. Eng.; 1: No. 5, 475-492(Nov 1971).

From third international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

National and international transport regulations specify numerous test conditions which packages of radioactive and other hazardous materials must be capable of withstanding. The tests were developed by many groups, usually to solve some specific problem. This presentation raises several questions regarding how well the tests represent the transport environment and what should be done to improve our understanding of this environment in order that package tests may be improved. A study for the Department of Transportation by General American Research Division (GARD) has just been completed—a survey of the testing methods and practices currently employed for evaluation of packages. Results of this study are reviewed. Other needed studies are identified. (auth)

34129 IMPACT TESTS OF MODELS AT THE SAVANNAH RIVER PLANT. Langhaar, J. W. (E. I. du Pont de Nemours and Co., Aiken, SC). Int. J. Radiat. Eng.; 1: No. 5, 517-536(Nov 1971).

From third international symposium on packaging and transportation of radioactive materials; Richland, WA (16 Aug 1971).

Impact testing of small-scale shipping cask models for assessing gross deformation resistance to puncture, behavior of welds, and certain other physical attributes has been theoretically established and experimentally verified. For evaluation of the strength of bolted fastenings and leakage of closures, the validity of model testing is not so well proven but is nevertheless often considered the most reliable practical method available. The Savannah River Plant has tested numerous models in recent years and sometimes a full-size mockup of part of a package. Results in some cases have confirmed predictions and other cases have necessitated a change in design. Several of the tests are described. The need for further study of methods of modeling closures is emphasized. (auth)

34130 FUEL ASSEMBLY TRANSPORTATION DEVICE. Kido, T.; Kan, Y.; Morishima, A.; Shiratori, T. (to Sumitomo Electric Industries Ltd., Osaka (Japan)). Japanese Patent 1973-24999/B/. 15 Jun 1967. 6p. (In Japanese).

A nuclear fuel assembly is provided which is capable of transporting equally spaced fuel assemblies which are disposed horizontally. The assembly is comprised of bisectional inner frames and bisectional outer frames. The terminal ends of said internal and outer frames are provided with striped grids. The striped grids of the internal frame are combined with those of the outer frame such that they cross vertically with a variation of 90°. The thus arranged net-shaped grids are formed to stabilize the fuel assembly. This novel device allows the fuel assembly to be free from damage caused by vibration when cutting off both terminal ends of the fuel rod by sawing. Furthermore, structure simplicity lessens operational failure. Finally, the use of aluminium material allows the fuel assembly to be irradiated and supplied at reasonable price. (JA)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 34882.

34131 (AECL-4931) PHYSICS DIVISION PROGRESS REPORT, JULY 1 TO SEPTEMBER 30, 1974. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1974. 87p. (PR-P-103). Dep. NTIS (U. S. Sales Only) $7.25. AECL $2.00.

MP tandem operation is reviewed, including mechanical problems with the Pelletron charging chain and rewiring of the ^{3}QD spectrometer. Studies of cluster structure by ^{3}He + ^{7}Li were begun. The lifetimes of ^{48}V, ^{50}Mn, and ^{54}Co were determined. In the course of identifying a new beta-delayed proton emitter (^{69}Se), a novel method of estimating very short nuclear lifetimes (10^{-16} to 10^{-17} s) was studied. The technique of determining nuclear lifetimes by inverse reactions was pursued. Work on the on-line separator, Compton and bremsstrahlung monochromators, and neutron spectrometers was recounted. Studies were made on the vibrational excitations in deuterated benzene and magnetic excitation in rubidium cobalt fluoride, as well as the temperature and deformation dependence of positron annihilation in Cu. Two new cryostat assemblies for semiconductor detectors were designed. In the area of applied studies and computation, work continued on the simulation of the Bruce Heavy Water Plant. The FORSIM simulation package was extended by incorporating a new integration algorithm to improve the efficiency of handling large sparse matrices. FORSIM was applied to a problem in neutron kinetics, the determination of density and temperature in standing shock waves, a problem involving corrosion and deposition in reactor fuel elements, and a two-phase flow analysis of coolant circuits. Further improvements were made to the heat transfer program TRUMP, and an analysis of a fire accident in a spent fuel shipping container was carried out. Four papers are indexed separately. (3 tables) (RWR)

For title listings of selected papers see: 34746, 34773, 34826, and 34843.

34132 (JAERI-M-5567, pp 145-152) DESIGN AND NEW FEATURES OF A THREE-STAGE TANDEM AT KYUSHU UNIVERSITY. Isoya, A. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

A scope of the project and new design features of the 10 MV tandem under construction are presented. In the three-stage operation, combining an existing single-stage Van de Graaff, it will produce a hydrogen ion beam of 25 MeV. The design is also made with a stress on the acceleration of very heavy ions. (auth)

34133 (LBL-3686) BEVALAC: A HIGH-ENERGY HEAVY-ION FACILITY. Status and Outlook. Grunder, H. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 4 Mar 1975. Contract W-7405-eng-48. 7p. Dep. NTIS $4.00.

The high-energy heavy-ion facility, which has commonly been referred to as the Bevalac, is a synchrotron with Bρ of 9000 [kG-in or 2.3×10^{2} kG-m] having special injectors. The synchrotron has three injectors. The 50 MeV proton injector, originally from BNL, is a tool left over from the high-energy high-intensity days of this productive synchrotron. The 20 MeV linac is a proton linac, designed so conservatively that it was possible to accelerate modest but useful beams of ^{12}C, ^{14}N, and ^{16}O as well as deuterons and alpha particles in the 2$\beta\lambda$ mode. This was accomplished in 1971. After our first trials, a suggestion made earlier by A. Ghiorso to inject from the SuperHILAC into the synchrotron was actively pursued. Reasons as to why the SuperHILAC is being used as injector to the Bevatron are given. (WHK)

34134 (OULNS-74-1) ANNUAL REPORT OF LABORATORY OF NUCLEAR STUDIES, OSAKA UNIVERSITY. Jan. 1973–Dec. 1973. (Osaka Univ., Toyonaka (Japan). Lab. of Nuclear Studies). [nd]. 86p. INIS.

Activities of the OULNS for the period of January to December 1973 are described in individual short reports: Cyclotron Division, High Voltage Accelerator Division, Mass Spectroscopy Division, Radioisotope Division, and Theoretical Division. Publications during the year, with abstracts, are also presented. (JA)

34135 (SAND-74-5872) COLLECTIVE ION ACCELERATION WITH INTENSE ELECTRON BEAMS. Olson, C. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 29p. (CONF-750335-12). Dep. NTIS $4.50.

From particle accelerator conference; Washington, District of Columbia, USA (12 Mar 1975).

Collective acceleration methods that employ an intense relativistic electron beam (IREB) are discussed. A brief history and a classification of collective acceleration methods are given. Methods examined include IREB injection into neutral gas; IREB injection into vacuum; plasma-filled IREB diodes; and vacuum-filled IREB diodes. Accelerating fields of order 10^{6} V/cm have been observed experimentally. The collective acceleration processes for IREB injection into neutral gas and vacuum are discussed. It is noted that the collective acceleration processes for IREB diodes have not been elucidated yet. A summary of present collective ion acceleration research areas that involve IREB's is given. (143 references) (auth)

34136 IMPROVED KYOTO UNIVERSITY CYCLOTRON. Uemura, Y.; Fukunaga, K.; Kakigi, S.; Yanabu, T.; Fujiwara, N. (Kyoto Univ., Uji (Japan). Inst. for Chemical Research). Bull. Inst. Chem. Res., Kyoto Univ.; 52: No. 1, 87-123(Jul 1974).

The 105 cm Kyoto University Cyclotron built in 1952 through 1955 expired its life span and was remodeled since 1969. All parts of the old cyclotron were replaced with new ones except the main magnet. Efforts to increase the beam intensity, to make the beam energy variable, to accelerate various kinds of ions and to get simple handling and reliable control are described. The design principle and the performance characteristics of ion acceleration with the renewed cyclotron are described. (auth)

34137 RESIDUAL RADIO-ACTIVITY OF KYOTO UNIVERSITY CYCLOTRON. Uemura, Y. (Kyoto Univ., Uji (Japan). Inst. for Chemical Research); Nishi, T.; Imanishi, N.; Fujiwara, I. Bull. Inst. Chem. Res., Kyoto Univ.; 52: No. 1, 124-131(Jul 1974).

The residual radioactivity of the Kyoto University Cyclotron was surveyed about one year after its shutdown and before its reconstruction. The radioactivity remaining in the electrodes of the cyclotron and in the dust was determined. (auth)

34138 KEK ANNUAL REPORT, 1972. KEK Annu. Rep. (Natl. Lab. High Energy Phys.); No. 972, 1-139([nd]).

The National Laboratory for High Energy Physics (KEK) was established in April 1971; which is designed for joint use by university scientists. The central facility of KEK is an 8 GeV proton synchrotron. It will be completed in early 1975. Most of the buildings to house its components, as well as the main ring tunnel, were completed, with construction of the components proceeding as scheduled, during the fiscal year 1972. Activities of the KEK for the period of April 1972 to March 1973 are described: accelerator department, physics department, scientific and technical service department, and so on. (JA)

34139 A 100 keV ACCELERATING UNIT FOR RADIATION STUDIES. Spirin, G. S.; Starodubtsev, S. V. pp 338-341 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

A description is presented for a unit used in studying the radiation effects of ions energies of 50 to 300 keV. Requirements dealing with beam purity, monochromaticity of the beam, stability and regulation of beam intensity are explained. The unit consists of an ion source, two acceleration sections, an electromagnetic separator, a scanning condenser and a target chamber. Hydrogen is fed to the ionization chamber from a steel cylinder. The accelerator can be operated in a pulse mode. A current strength of 1 to 30 μamps is obtained. This ion current to the target is stabilized and integrated by a special electrical arrangement. (SJR)

34140 STABILIZATION SYSTEM AND BEAM CURRENT INTEGRATION OF A 100 keV ACCELERATOR. Starodubtsev, S. V.; Spirin, G. S. pp 341-344 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

Beam scanning by deflection in the field of a condenser is used to assure homogeneous irradiation of a sample in an accelerator. Stabilization of the ion current to the sample is based on the expectation that the average ion current is a function of the amplitude of the scanning voltage. The operation of the integrator consists in turning on the counting arrangement for a period of time proportional to the average ion current to the target and feeding in pulses having a constant frequency. With this scheme it is pos-

sible to stabilize the average ion current to about 1.5% with an integration accuracy of 1.0%. (SJR)

34141 THE 1 MeV ACCELERATOR OF THE UZBEK ACADEMY OF SCIENCES. Starodubtsev, S. V.; Khamidov, N.; Kel'man, M. Kh. pp 351-364 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

This unit was designed as a direct-acting accelerator at relatively low energies of accelerated particles but with a beam having a rather large current strength on the order of a few hundred milliamperes. By means of the symmetrical optical system it is possible to accelerate either positive or negative charged particles such as electrons, protons, deuterons and alpha particles. On the other hand this accelerator could also be a powerful generator of fast neutrons by reacting a deuteron beam with a deuterium or tritium target. While accelerating electrons, it could also be used as a powerful source of x rays. The construction, the high-voltage feed system, the control system, the vacuum system and operation of the accelerator are described. (SJR)

34142 ELECTRON ACCELERATOR. Ito, K.; Aiura, M. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1973-18997/B/. 23 Jul 1969. 5p. (In Japanese).

Linear electron accelerators are used in medical applications, radiography, electron bombardment, and for research purposes, etc. In these applications, it is often required that the output energy of the accelerator be capable of being changed. The present invention improves upon the conventional accelerators so that the output energy can be made variable. The present accelerator consists of a pulse generator, a power source, an rf-oscillator, an electron gun modulator, a hybrid circuit, an accelerator tube, a phase shifter, and an absorption resistor. An output pulse of the pulse generator is sent to the rf-oscillator through the power source and drives the rf-oscillator. The output pulse of the pulse generator also is sent to the electron gun modulator. The high frequency output of the rf-oscillator enters the input terminal (a) of the hybrid circuit and the output of the circuit goes from output terminal (b) to the accelerator tube. On the other hand, the modulator output modulates the electron gun, and a pulsed electron beam from the gun is guided to the accelerator tube. The outputs of the hybrid circuit and the electron gun interact with each other in the accelerator tube, and the acceleration of electrons takes place to provide an electron beam having a velocity close to the velocity of light. The high frequency power which has been used to accelerate the electron beam is now phase-shifted and sent to the (c) terminal of the hybrid circuit. The output energy from terminal (d) of the circuit is guided to the absorption resister where the electric power is converted to heat. The hybrid circuit is such that the output of terminal (b) is varied by varying the phase relation between two inputs on terminal (a) and (c). Hence the output energy of the accelerator tube can be changed by varying the amount of phase shift by means of the phase shifter. (JA)

34143 DESIGN AND CONSTRUCTION OF JAERI-LINAC. Takekoshi, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Bull. Inst. Chem. Res., Kyoto Univ.; 52: No. 1, 47-57(Jul 1974).

The design and construction of a new linear accelerator at the JAERI (Japan Atomic Energy Research Institute) is described together with its performance. The machine is constructed from five accelerating waveguide sections, two of which have a length of 2 m each, the remainder have 3 m each. The electron beam current of 1 mA at 190 MeV energy, and 600 mA at 100 MeV with a pulse width of 0.5 μ sec is obtained when a RF power of 20 MW with a frequency of 2,857 MHz fed into each accelerator section. The range of the pulse width of the electron beam is from 0.01 to 2 μ sec and the current amplitudes from the dark current threshold to 600 mA, and the repetition rates are from single shot to 600 pps. The main research program in the use of this linac is to obtain nuclear data needed for the development of nuclear reactors. In addition, the linac is used as a strong electron and x-ray source in the studies of neutron physics, nuclear physics, solid state physics, radiation chemistry, and shielding technology, etc. (auth)

Auxiliaries and Components

Refer also to abstract 33275.

34144 (UCRL-74138) LLL 100-MeV ELECTRON LINAC: DESIGN CONSIDERATIONS AND PERFORMANCE OF THE BEAM-TRANSPORT VACUUM SYSTEM. Lara, M. C.; Brooks, H. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Mar 1975. 6p. (CONF-750332-1). Dep. NTIS $4.00.

From meeting of the American Physical Society; Washington, District of Columbia, USA (12 Mar 1975).

The vacuum system for the beam-transport lines used with the Lawrence Livermore Laboratory 100-MeV electron-positron linear accelerator is described. It is operated in the high (10^{-4} to 10^{-5} Pa) range using standard ion pumps with turbomolecular pumps for roughdown. Also, the important factors considered during the initial design phases are reviewed. These factors have contributed to the very reliable performance of the vacuum system since its startup five years ago. The cleaning and handling procedures used on the beam-transport lines, magnet vacuum chambers, and other vacuum components are discussed. (auth)

34145 CORRECTION OF AN ACCELERATING VOLTAGE PULSE FORM IN A HIGH-CURRENT PULSE ELECTRON ACCELERATOR. Kremnev, V. V.; Reznikov, V. P. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 125-127(1974). (In Russian).

Expressions are derived for the pulse duration and the length of the forming lines in a high-current pulse electron accelerator. (JSR)

34146 SOME EXPERIMENTS ON THE RADIOFREQUENCY SYSTEM OF THE IMPROVED KYOTO UNIVERSITY CYCLOTRON. Fujiwara, N.; Ohsawa, T.; Miyanaga, T.; Nguyen, D. C.; Fukunaga, K. (Kyoto Univ., Uji (Japan). Inst. for Chemical Research). Bull. Inst. Chem. Res., Kyoto Univ.; 52: No. 1, 70-86(Jul 1974).

Characteristics of the r.f. system of the improved cyclotron are described. The frequency of the r.f. system varies from 10 MHz to 19 MHz by changing the position of the shorting plate inside the resonant line. Frequency trimming is possible with a capacitor and an inductive loop. The two step excitation method is applied to get high devoltage without suffering from the multifactoring phenomena. (auth)

34147 OPTIMUM POLE SHAPE FOR SEXTUPOLE MAGNET HAVING CIRCULAR POLE TIPS. Tanabe, T. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study); Kobayashi, M. Bull. Inst. Chem. Res., Kyoto Univ.; 52: No. 1, 63-69(Jul 1974).

Harmonic field components in sextupole magnets having circular pole tips are numerically obtained by using a two dimensional scalar potential under assumed boundary conditions. Optimum radii of pole tips are found for various depths of coil slots. (auth)

34148 CALORIMETRIC MEASUREMENTS AT ACCELERATORS. Chapter 6. Shimanskaya, N. S. pp 149-180 of Ionizing Radiation Calorimetry. Moscow; Atomizdat (1973). (In Russian).

This chapter of the monograph describes the technique and features of calorimetric units for measuring beams of charged and neutral particles at accelerators. Features of calorimetric measurements on electron accelerators are considered. A description is given of the technique of measuring calorimetrically beams of bremsstrahlung radiation and beams of high-energy particles. (tr-SJR)

34149 A STUDY ON SHIELDING FOR BETATRON. IV. Scattering of High Energy X-Rays. Maruyama, T.; Kumamoto, Y.; Hashizume, T. (National Inst. of Radiological Sciences, Chiba (Japan)); Hattori, H.; Kanamori, H. Shimadzu Hyoron; 31: No. 3, 93-96(Sep 1974). (In Japanese).

The secondary radiation doses scattered from a water phantom and various shielding materials (ordinary concrete, heavy concrete, iron and lead) were determined for high-energy x-rays of 4, 6, 10, 20 and 30 MV from a Shimadzu Bt-32 betatron for the purpose of shielding design against high-energy x-rays. The relative doses from radiation scattered at the angles of 45°, 90° and 135° were measured at 1 m from these scattering materials. Expressed ratios of scattered radiation dose to the incident x-ray dose at the surface of scatterer per 1 m^2 of scattering area, the ratios varied depending on the scattering angle, incident x-ray energy, scattering material and the angle between the direction of the incident beam and the scatterer, and ranged from the minimum value of 2.8×10^{-3} to the maximum value of 16.2×10^{-2}. (auth)

34150 A STUDY ON SHIELDING FOR A BETATRON. V. Characteristics of Leakage Radiations from a Betatron. Maruyama, T.; Kumamoto, Y.; Hashizume, T. (National Inst. of Radiological Sciences, Chiba (Japan)); Hattori, H.; Sakata, S. Shimadzu Hyoron; 31: No. 3, 97-99(Sep 1974). (In Japanese).

The characteristics of leakage radiation from a Shimadzu BT-32 betatron was determined by means of the attenuation measurements in ordinary concrete using an ionization chamber. The measurements were made on leakage radiations in two directions from the betatron which was operated at the nominal energies of 6, 10, 20 and 30 MeV. When the betatron was operated at 10 MeV

or more, a tenth-value thickness of ordinary concrete for leakage radiations was comparable to that for 15 MV primary X-rays. For 6 MeV operation energy, the thickness corresponded to that of 8 MV primary X-rays. (auth)

34151 ELECTRON BEAM MONITORING DOSIMETER. Fujinaga, T. (to Mitsubishi Heavy Industries, Ltd., Tokyo (Japan)). Japanese Patent 1973-26310/B/. 25 Jan 1968. 4p. (In Japanese).

The present invention relates to an electron beam monitoring dosimeter for monitoring the exposure dose by a scatterer or the ionization rate in the air resulting from secondary electrons without direct measurement of the penetrating electron beams. The purpose of this invention is to provide the electron beam monitoring dosimeter which functions as stated above and which facilitates the measurement of the ionization rate in the air, promotes accuracy in measurement, and finally is easy to maintain. An outer casing with a circular opening from which an electron beam is emitted and a scatterer opposite to said opening in said casing are provided at the side of said opening. Further equipped with an annular ionization chamber with a sensitive element coaxially large in diameter as in said opening, the ionization rate in the air of the said outer casing can be measured by said ionization chamber. Thus, the measurement of electron beams is easier and the accuracy thereof is promoted. Furthermore, this novel dosimeter allows highly efficient measurement to be carried out. (JA)

34152 CORPUSCULAR BEAM ENERGY SELECTOR. Koike, H. (to Japan Electron Optics Lab. Co. Ltd., Akishima, Tokyo). Japanese Patent 1973-24916/B/. 27 Mar 1968. 3p. (In Japanese).

The present invention relates to the corpuscular beam energy selector which picks out solely the corpuscular beam having a desired value by separating a corpuscular beam such as an electron beam or an ion beam according to energy. The purpose of this invention is to provide a highly accurate apparatus for separating and selecting a corpuscular beam by applying two sets of electrostatic lenses. In the above selector, two sets of electrostatic lenses and a magnetic pole for orienting the deflecting magnetic field are provided. One of the electrostatic lenses allows solely the corpuscular beam having energy below the highest value in the desired energy range to be reflected. Thus, the reflected corpuscular beam is allowed to pass through in order to select the corpuscular beam having the desired energy range. Thus, the velocity of the corpuscular beam to be selected can be controlled by controlling the electric potential induced in the second electrode of said electrostatic lenses. Furthermore, one of electrostatic lenses can be used for integral action, thus being advantageous in the application. (JA)

34153 LINEAR ELECTRON ACCELERATOR. Shigemura, N. (to Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Japanese Patent 1973-18993/B/. 23 Jul 1969. 4p. (In Japanese).

A linear electron accelerator is often equipped with a deflecting magnet to deflect the electron beam by 90°, 105° etc. The deflecting angle is changed by variation of the electron energy. In the conventional systems, the change in the deflecting angle is corrected by varying the strength of the deflecting magnet field, but in this case, the electron energy can not be maintained at a predetermined value. The present invention provides a linear electron accelerator in which the deflecting angle is corrected by automatically correcting the output energy of the accelerator. In the present system, a drift space of 20 cm in length is provided between the electron gun and the accelerator tube, and an electron beam control magnet and slit are placed in this space. The electron beam from the electron gun is converged by the control magnet and passes through the slit. The amount of the electron beam which passes through the slit can be varied by the excitation current of the control magnet. The electron beam is now accelerated through the acceleration tube and deflected by 90° for example, by the deflecting magnet. Two radiation detectors are symmetrically placed at the output and detect the radiation strength at these two positions. The output of the detectors are fed into a differential amplifier to obtain the difference in the radiation strength. The output of the amplifier occurs when the beam position deviates from the neutral position. The output signal of the amplifier controls the excitation current of the electron beam control magnet to change the energy of the electrons which enter the accelerating tube. In this way the energy of the accelerated electron is readjusted to correct the deflecting angle of the beam. (JA)

Ion Sources and Injection and Extraction Systems

Refer also to abstract 34704.

34154 (ANL/HEP-75-02) PROCEEDINGS OF THE SUMMER STUDY ON HIGH-ENERGY PHYSICS WITH POLARIZED BEAMS, ARGONNE, ILLINOIS, JULY 22–26, 1974. Roberts, J. B. (ed.). (Argonne National Lab., Ill. (USA)). 1974. 617p. Dep. NTIS $34.00.

Thirty-two papers were presented at the conference. A separate abstract was prepared for each paper. (LBS)

For abstracts of individual papers see: 34155–34163, 34176, 34180, 34181, 34589–34595, 34626, 34642, 34674, 34698, 34703–34706, 34721, 34724, 34879, 34983, and 34984.

34155 (ANL/HEP-75-02, pp VIII.1-VIII.23) MONOENERGETIC POLARIZED NEUTRON BEAM AT THE ZGS. Meyer, W. T. 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

The feasibility of a monoenergetic polarized neutron beam produced by the dissociation of polarized deuterons from the Argonne ZGS is investigated. Intensities on the order of 10^5 neutrons per pulse with polarizations of 50 percent seem achievable, based on calculations of Coulomb photodisintegration using a Weizsäcker-Williams approximation. Several plans for realizing such a beam are presented. (auth)

34156 (ANL/HEP-75-02, pp X.1-X.17) POLARIZED ION SOURCES. Glavish, H. F. (Stanford Univ., CA). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

A brief account is given of the motivation for building polarized ion sources. This is followed by a simple description of the basic principles of the "ground state" and "Lamb shift" types of sources. The performance levels currently achieved are discussed and detailed diagrams of actual sources are included. References are given which relate to the possibility of producing polarized particles other than protons and deuterons. Finally, speculations are made on developments in the ground state type of source that might lead to increased beam currents. (auth)

34157 (ANL/HEP-75-02, pp XI.1-XI.16) POLARIZED PROTON ACCELERATION AT THE ZGS. Parker, E. F. 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

In July 1973, the world's first high energy polarized proton beam was produced at the Argonne National Laboratory (ANL) Zero Gradient Synchrotron (ZGS). This represented the successful conclusion of a two-year joint effort by ANL and the University of Michigan to produce such a facility. To date, there have been three one-month runs using polarized protons for high energy physics experiments. This report will briefly describe the polarized beam facility, the experiences with it, and the near-term improvement goals. (auth)

34158 (ANL/HEP-75-02, pp XIII.1-XIII.11) DEPOLARIZATION OF A POLARIZED PROTON BEAM IN A CIRCULAR ACCELERATOR. Teng, L. C. (Fermi National Accelerator Lab., Batavia, Il). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

A general review is given of the theory of depolarization of a polarized proton beam and a few formulas for quick estimates of the effect are presented. (LBS)

34159 (ANL-HEP-75-02, pp XIV.1-XIV.20) POSSIBILITY OF ACCELERATION OF POLARIZED PROTONS IN THE CERN-PS. Mohl, P. (CERN, Geneva). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

The acceleration of vertically polarized protons in a strong focusing synchrotron like the PS requires efficient antidotes against depolarizing resonances. Such antidotes (efficient orbit correction, fast tune jumping and/or adiabatic resonance crossing) are now well established, so that one could hope to accelerate polarized protons to a respectable energy in the PS—although very probably not top energy. Polarized protons (and neutrons) can also be obtained via acceleration and stripping of polarized deuterons. This looks much easier from the point of view of depolarizing resonances. The loss in phase-space density during stripping seems acceptable for fixed target experiments but undesirable for stacking of the protons. (auth)

34160 (ANL/HEP-75-02, pp XVI.1-XVI.13) POLARIZED JET TARGETS. Yovanovitch, D. D. (Fermi National Accelerator Lab., Batavia, IL). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

A description is given of a technique of a gas hydrogen (deuterium) jet target in use at NAL. It is shown how a similar technique can be applied using a polarized atomic beam. (LBS)

34161 (ANL/HEP-75-02, pp XVII.1-XVII.6) POSSIBILITY OF POLARIZED PROTONS IN THE CERN ISR. Hereward, H. G. (CERN, Geneva). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

The stacking and storing of protons by the usual ISR method are discussed. Calculations of the interaction rate, depolarization resonances, direct collision depolarization, and indirect collision depolarization are reported. (LBS)

34162 (ANL/HEP-75-02, pp XVIII.1-XVIII.8) POLARIZED H^- SOURCE FOR LAMPF. McKibben, J. L.; Stevens, R. R. Jr.; Allison, P.; Hardekipf, R. A. (Los Alamos Scientific Lab., NM). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

A polarized source is being constructed for the Los Alamos Meson Physics Facility (LAMPF). This source will be an H^- source in order that the polarized beam can be accelerated simultaneously with an intense H^+ beam. The Lamb-shift type of source was chosen and will be located within the large terminal of a 750-kV Cockcroft-Walton (C-W) generator. Several features are being incorporated to increase the intensity available, since the duty factor of LAMPF is only 6%. The basic feature of the design is that the source will accommodate a larger size of metastable beam in order to better match the emittance of the beam to the acceptance of the argon cell. A magnetic lens located about 20 cm downstream from the accel-decel lens will hopefully increase the intensity but requires that the bore of the cesium cell be increased from 1 cm to about 2.5 cm. The spin filter will be markedly shortened to increase the output beam. The argon cell will be pumped cryogenically using a 10-W helium-cycle refrigerator operating at about 15°K. The lens system will be similar to that in the unpolarized H^- source. Apparatus for rapidly reversing the direction of polarization is described. (auth)

34163 (ANL/HEP-75-02, pp XIX.1-XIX.7) POLARIZED Λ BEAM AT THE ZGS. Romanowski, T. A. (Ohio State Univ., Columbus). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

Some general problems which would be encountered in designing and building a polarized Λ beam are discussed. (LBS)

34164 (JAERI-M-5567, pp 167-169) DIRECT EXTRACTION NEGATIVE ION SOURCE FOR TANDEM ACCELERATOR. Nogami, Y. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Performance of a direct extraction negative ion source (abbreviated to DENIS) for the tandem accelerator of University of Tokyo is reported. (auth)

34165 (JAERI-M-5567, pp 170-173) ACCELERATION OF NITROGEN AND ARGON IONS FROM PIG ION SOURCE. Kobayashi, C.; Kanda, S.; Yoshida, K. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

The results of nitrogen and argon ion acceleration by the JAERI 2 MV Van de Graaff accelerator with a cold-cathode PIG ion source are given. The beam currents of N^+ and Ar^{2+} were 3.5 μA and 1.25 μA on a target, respectively. The lifetime of the ion source was about 200 hours for nitrogen and 50 hours for argon. (auth)

34166 (JAERI-M-5567, pp 174-178) ION SOURCES FOR NEGATIVE HEAVY IONS. Yamanouchi, M. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

A negative heavy ion source recently developed by R. Middleton and C. T. Adams is reviewed briefly. Some measures are proposed to improve the ion source. A pilot ion source has been constructed in our laboratory and the investigation is in progress. Characteristic curves of an ion gun equipped with a front-feed-type ionizer are presented. Although the result is not conclusive yet, the front-feed-type ionizer seems promising for its simple structure and long life. (auth)

34167 (JAERI-M-5567, pp 179-184) PERFORMANCE OF MULTIPLY-CHARGED HEAVY ION SOURCE AND ACCELERATION OF HEAVY IONS IN THE IPCR CYCLOTRON. Kohno, I. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

The design and performance of the multiply-charged heavy ion source which is now used in the IPCR cyclotron are described. At present, C^{4+}, N^{4+}, O^{4+}, and O^{5+} ions are produced in the source and accelerated in the ranges of energies 48 to 100, 56 to 100, 70 to 95, and 70 to 125 MeV respectively, by the cyclotron. Production of multiply-charged ions of Ne, Ar, Kr, and Xe has been studied by use of this ion source. Several ions, such as Ne^{4+}, Ne^{5+}, Ar^{8+}, Ar^{7+}, Ar^{8+}, Kr^{7+}, Kr^{8+}, Kr^{9+}, Xe^{9+}, Xe^{10+}, and Xe^{11+} have been observed. (auth)

34168 (JAERI-M-5567, pp 185-191) PRODUCTION OF MULTIPLY CHARGED IONS BY LASER BEAMS. Yamanaka, T.; Yamanaka, C. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

The ionization of atoms in high temperature laser plasma is a promising method from the point of view of obtaining multiply-charged ions and their use in accelerator injectors. High power laser system is briefly discussed. The properties of multiply ionized ions are surveyed. Ions with $z = 25$ have already been obtained by bombardment of solid targets with high power glass lasers. (auth)

34169 DEVELOPMENT OF AN AXIAL BEAM GUIDANCE SYSTEM FOR ELEMENTARY POLARIZED IONS IN THE ISOCHRONOUS CYCLOTRON OF BONN UNIVERSITY. Scholzen, A.; Hammon, W.; Penselin, S.; Schumacher, W. (Bonn Univ. (F. R. Germany). Inst. fuer Angewandte Physik). Nucl. Instrum. Methods; 123: No. 2, 327-330(15 Jan 1975). (In German).

A beam transport system for the axial injection of polarized protons and deuterons was developed at the Bonn isochronous cyclotron. The injection system, whose elements are 3 einzel-lenses and 4 electrostatic quadrupole lenses, brings the beam 225 cm upwards through a hole in the lower yoke of the magnet to the cyclotron median plane. A hyperboloid inflector inflects the beam for further acceleration. Beam adjustment is possible by steering systems and simple monitoring devices. Unpolarized ion beams can be injected into the beam transport system through a second inflector. The transmission of the system was estimated by tests outside of the cyclotron. For proton injection energies (2 to 4 keV) the transmission between source and inflector is 30 to 50%, for deuterons (4 to 8 keV) 60%. (auth)

34170 ELECTRON ACCELERATOR. Arakawa, K.; Shinohara, K. (to Matsushita Electric Industrial Co. Ltd., Kadoma, Osaka (Japan)). Japanese Patent 1973-18995/B/. 14 Jul 1969. 3p. (In Japanese).

This invention relates to an electron accelerator in which a plurality of cathode filaments are placed inside a vacuum system in order to avoid interruption of operation during replacement of filaments. The accelerator consists of a chamber filled with an insulating gas, an electron gun, an accelerating tube, and a deflecting coil which is disposed in the chamber. A beam correcting coil is also disposed in the chamber. When a particular filament is to be operated, a definite amount of electric current flows in the correcting coil so that the electron beam is adjusted to coincide with the accelerating tube axis. Of course, the amount of current depends upon the position of the filament to be operated. The beam position is automatically corrected by signals from a monitor electrode which monitors the position of the electron beam. (JA)

Ion Optics and Field Calculations

34171 INSTABILITY OF INTENSE ELECTRON CURRENTS AT RELATIVISTIC ENERGIES IN AN AIR-COIL BETATRON WITH STELLARATOR FIELD. Melke, J. Aachen; Univ. Aachen (1972). 85p. (In German).

Thesis.

The manner of functioning of an air-coil betatron with superimposed stellarator field is investigated with special regard to the limiting behavior at higher energies. The measured results show that the inductive coupling between betatron and stellarator field coil gives rise to a magnetic interference field perpendicular to the electron beam of the order of magnitude of 10^{-4} of the stable

main field. Furthermore, it can be experimentally shown that the predicted resonance conditions due to field interferences influence the electron intensity. Summarizing, one can say that the preconditions for the self-focussing of a relativistic electron beam in its self-consistent field can hardly be fulfilled by means of the betatron acceleration in stabilizing stellarator fields. (GE)

34172 TRANSIENT RADIATION OF A PARTICLE BEAM IN A SLOW WAVE ACCELERATING STRUCTURE. Marcou, J. (Paris-11 Univ., 91 - Orsay (France). Inst. d'Electronique Fondamentale). Nucl. Instrum. Methods; 123: No. 2, 205-215 (15 Jan 1975).

A new method derived from Slater's well known method dealing with cavities, is used to describe the transient radiation of a particle beam travelling through a slow wave structure. Patterns and features of the radiated field are studied according to several factors: location of the observation point, trajectory length, and dispersion law of the waveguide. A rigorous analytical expression and a good approximate formula are given for the energy lost by each bunch composing a beam current pulse. In the case of very short pulses, results differ from those given by the classical beam-loading theories for linacs. This difference is due, not to the dispersion law of the TM_{01} mode, but to the contribution of the totality of higher modes excited in the iris-loaded waveguide. The excited waves have a phase velocity equal or very near to the beam velocity. The importance of this synchronism suggests the possibility of using the radiated field to measure the particle velocity. (auth)

34173 THIRD-ORDER TRANSFER MATRICES FOR AN ELECTROSTATIC QUADRUPOLE LENS. Fujita, Y.; Matsuda, H. (Osaka Univ., Toyonaka (Japan). Coll. of General Education). Nucl. Instrum. Methods; 123: No. 3, 495-504(1 Feb 1975).

The matrix elements of the third-order transfer matrices for the electrostatic quadrupole lens are calculated by solving the relativistic equation of motion. The results are arranged as 31 × 31 matrices including terms which originate from particles having different energies. The relativistic correction is necessary for the influence of the fringing field, and the corrected matrix elements are also given. (auth)

34174 FOCUSSING FOR DIPOLE MAGNETS WITH LARGE POLE GAP TO BENDING RADIUS RATIOS. Heighway, E. A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nucl. Instrum. Methods; 123: No. 3, 413-419(1 Feb 1975).

The effect of pole face rotation on the axial focussing of dipole magnets is described for the case of small bending radius large pole gap magnets. An analytical expression is given which describes the focussing properties over the range of pole face rotation from −45° to +45°, and over the range of pole gap to bending radius ratio 0 to 0.5 and for the fringing field integral coefficient k from 0 to 0.4. (auth)

34175 MAXIMUM CURRENT OF BEAM WITH FINITE PHASE VOLUME. Trubnikov, G. I.; Kuznetsov, V. S. (Scientific-Research Inst. of Electrophysical Apparatus, Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 19: No. 6, 715-716(Dec 1974).

Translated from Zh. Tekh. Fiz.; 44: No. 6, 1129-1132(June 1974).

A universal curve giving the conditions for maximum current of an axisymmetric beam with finite phase volume is derived. This curve is the boundary of the region in which solutions for the beam envelope exist. Use of this curve to design a beam-transport channel is illustrated. (auth)

Storage Rings

34176 (ANL/HEP-75-02, pp XXX.1-XXX.11) ACCELERATION AND STORAGE OF POLARIZED BEAMS. Michel, L. (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

The equation for the precession of the polarization in a magnetic field is derived from first principles. The remainder of the discussion deals with the distinction between spin and polarization and with covariance. (LBS)

34177 (BNL-tr-588) EXPERIMENTAL FACILITY FOR ELECTRON COOLING. Anashin, V. V.; Budker, G. I.; Dikanskii, N. S. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. Translated by S. J. Amoretty of Preprint 74-86. 11p. Dep. NTIS $4.00.

The parameters of the NAP proton storage ring for investigation of electron cooling at the Institute for Nuclear Physics in Novosibirsk are given. Design and construction of the facility and various subassemblies were begun in November 1971. Work associated with the circulating beam was begun in September 1973. By April 1974 the study of the proton beam and of the characteristics of the storage ring and the final adjustment of the high-frequency system and of the computer were completed. In May 1974 experiments with use of two beams were begun. (WHK)

34178 (BNL-tr-591) KINETICS OF ELECTRON COOLING. Budker, G. I.; Derbenev, Ya. S.; Dikanskii, N. S.; Parkhomchuk, V. V.; Pestrikov, D. V.; Skrinskii, A. N. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. Translated by S. J. Amoretty of Preprint 74-85. 11p. Dep. NTIS $4.00.

To obtain high luminosity in heavy-particle storage rings, the colliding beams must be very dense. Since the synchrotron radiation is practically absent in heavy particles, other methods of damping the particle oscillations in storage rings must be found. In 1966 Budker proposed a method of electron cooling based on the transfer of the heat energy of a heavy-particle beam to an accompanying electron beam of lower temperature. An electron beam with an average velocity equal to the longitudinal velocity of the stored particles (protons, antiprotons) is formed in the ring's orbit. As a result of collision between the particles and electrons, the heat energy of protons is transferred to the electron beam; this decreases the size of the beam. The beam circulating in the electron storage ring is used at high proton energies (several BeV and higher). At low energies, however, one can use an electron beam in which the energy expended for electron acceleration can be recovered. Kinetics of the process are studied. (WHK)

34179 (BNL-tr-593) PRELIMINARY EXPERIMENTS ON ELECTRON COOLING. Budker, G. I.; Kikanskii, N. S.; Kudelainen, V. I.; Meshkov, I. N.; Parkhomchuk, V. V.; Pestrikov, D. V.; Skrinskii, A. N.; Sukhina, B. N. (Brookhaven National Lab., Upton, N. Y. (USA)). 1974. Translated by S. J. Amoretty of Preprint 74-87. 12p. Dep. NTIS $4.00.

A series of experiments on electron cooling (May-June 1974) was conducted at a proton energy of 65 MeV and an electron energy of ≈35 keV at the NAP storage ring facility. The experiments showed that reduction of the proton and electron velocities with an accuracy of $\leq 10^{-3}$ increased the lifetime of protons τ_p, attenuated the betatron oscillations, reduced energy straggling of the proton beam, and increased the acceleration or slowing down of protons by electrons. These effects vanished when the velocities were increased to $\approx 2 \times 10^{-3}$. After the protons had been accelerated to a specified energy the accelerating voltage was turned off and the protons circulated freely in a constant magnetic field. The electron beam facility was then turned on. The dependence on the proton energy of the yield of neutral hydrogen atoms and of the lifetime of the proton beam at fixed electron energy and 100-mA electron current is shown. (WHK)

Experimental Facilities

Refer also to abstracts 33253, 33271, 33274, 33346, 34882, and 34892.

34180 (ANL/HEP-75-02, pp VII.1-VII.10) DESIGN OF A HIGH ENERGY POLARIZED NEUTRON BEAM. Rosen, J. L. (Northwestern Univ., Evanston, IL). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

A simple procedure for polarizing a high energy neutron beam is described. A specific arrangement appropriate to the M3 beam line at the Fermi National Accelerator Laboratory is described. The design characteristics are: $>10^5$ neutrons/10^{12} interacting protons on target, effective energy range (150–300) GeV, mean polarization 20–25%. (auth)

34181 (ANL/HEP-75-02, pp XV.1-XV.23) REVIEW OF POLARIZED TARGETS. Hill, D. A. 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

The problem of polarizing hydrogen is briefly discussed in light of recent advances in magnet and cryogenic technology. The remainder of the discussion deals with polarized nuclei with $A < 4$. The spin pumping mechanism and the concept of frozen-spin targets are discussed. (LBS)

34182 (JAERI-M-5567, pp 53-58) AN AUTOMATIZED GONIOMETER SYSTEM FOR CHANNELING EXPERIMENTS. Nishijima, T.; Nashiyama, I.; Teranishi, E. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

A two-axes goniometer is prepared for channeling experiments in use of pulse-motor driving systems. The driving systems are linked with a particle detecting and a data storing systems, and measurements of channeling effect can be carried out automatically following to a preset scanning step angle in a set up scanning angle region. The step angle is 0.005° per pulse, and the accuracy of the angle setting is better than 0.02°, which is limited by the uncertainty of the gear mechanism in go-and-back motion. Several samples can be mounted on a movable sample holder and an appropriate sample or sample position can be selected out by sliding the holder with a pulse motor driving mechanism. The vacuum in the scattering chamber containing the goniometer is about 7×10^{-7} torr during experiments. Some examples of channeling measurements performed with this automatized system are also shown. (auth)

34183 (JAERI-M-5567, pp 215-218) ON-LINE EXPERIMENTS AT THE V.d.G. ACCELERATOR OF TOKYO INSTITUTE OF TECHNOLOGY. Adachi, M.; Ashibe, K.; Arai, E.; Ogawa, M. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Functional descriptions of the on-line apparatuses and/or programs which are used at the V.d.G. accelerator of Tokyo Institute of Technology are described briefly. (auth)

34184 (JAERI-M-5567, pp 231-235) THE TARGET PREPARATION TECHNIQUE IN HEAVY-ION EXPERIMENTS. Baba, S. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

The target preparation methods for studies of heavy-ion induced nuclear reactions are reviewed. Discussions are given on their advantages and disadvantages. (auth)

34185 (JAERI-M-5567, pp 236-239) BOMBARDMENT ACCOMPANIED WITH A LARGE HEAT EVOLUTION. Nozaki, T. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Counterplans for a large heat evolution during a high-flux charged particle bombardment are discussed. It is emphasized that the impedance for heat flow from the target substance to the coolant should be made as low as possible. (auth)

34186 (KHFTI-73-26, pp 58-60) METHODS OF THE MONOCRYSTAL TARGET PRECISE ORIENTATION ON THE RELATIVISTIC POSITRON BEAM. Morokhovskii, V. L.; Kasilov, V. I.; Kovalenko, G. D.; Fisun, A. N. (Physical-Technical Inst., Kharkov). 1973. (In Russian).

The use of a goniometer was proposed for a study of the effect of channeling of relativistic positrons for target orientation in order to ensure rotating the target around the three axes. The precision of calculation of the angle of turn was 5×10^{-5} rad. The method of orientation with the goniometer was studied on silicon monocrystal targets. (INIS)

34187 PULSED COLD NEUTRON SOURCE IN HOKKAIDO UNIVERSITY LINAC. Inoue, K.; Otomo, N.; Iwasa, H. (Hokkaido Univ., Sapporo (Japan). Faculty of Engineering). Hokkaido Daigaku Kogakubu Kenkyu Hokoku; No. 1, 179-185(Jun 1974). (In Japanese).

A description is given of the design and operation of the pulsed cold neutron source at the Hokkaido University LINAC. The cold moderator is solid methane, which is condensed and cooled by cooled helium gas. For the energy region 1 MeV the cold neutron beam flux is increased by a factor of 40. The high cold neutron intensity obtained is at present utilized for cold neutron time-of-flight experiments. An operational stability and safety of the facilities are recognized during operation of about 150 hours. (auth)

34188 EQUIPMENT FOR INVESTIGATING RADIATION EFFECTS IN SEMICONDUCTORS. Starodubtsev, S. V.; Spirin, G. S. pp 344-349 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

Physical studies of semiconductors irradiated with 130 keV protons were carried out in a Dewar flask enclosed in a vacuum chamber and cooled with liquid nitrogen. The heater could be withdrawn from the chamber into the sample holder for temperature control. Electrical leads were clamped to the surface of the irradiated samples. A magnet of constant field strength was used in measuring the photogalvanomagnetic effect. Provision is made to irradiate the sample with light or to register light from the sample. A variable-current bridge is used to control the temperature. A modulator is described by means of which it is possible to vary light intensity according to a double sinusoidal manner. The light flux to the sample consists of two beams whose intensities vary sinusoidally with frequencies and amplitudes independent of each other. (SJR)

34189 PARTICLE SEPARATION FOR COUNTER BEAMS IN THE 100 GeV/c MOMENTUM RANGE. Lengeler, H. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Instrum. Methods; 123: No. 2, 301-325(15 Jan 1975).

For the secondary particle intensities reached with the new proton-synchrotrons in the 100 GeV/c momentum range separation of kaons and antiprotons in counter experiments is interesting, even if a saturation range of a few 10^6 particles per pulse is considered. With the present-day technology only superconducting rf separators will provide a possibility of particle separation for momenta above 10 GeV/c. The development of rf superconductivity will allow in the near future the use of superconducting niobium deflectors whose performances will be well adapted to the 100 GeV/c momentum range. Unlike bubble chambers, counter systems do not need a high beam purity and the separation conditions can be relaxed, enabling for a given deflection higher acceptances and higher upper limits of separation. Some properties of superconducting deflectors are discussed and some guide-lines for the choice of parameters for a separator and for separated beams are given. It is shown that the upper limit for the working frequency of rf separators lies around 10 GHz (X-band). The rf separated beams are characterized by very small acceptances and momentum bites (a few μrad, $\Delta p/p \approx 1\%$). Two possible rf separated beams with X-band separators for the CERN West experimental area and the extended North experimental area with a momentum range of 20 to 80 GeV/c and 60 to 200 GeV/c respectively are discussed. It is shown that with acceptances of a few μsr, a relative momentum bite of 1%, and 10^{12} interacting protons at the target a gain in wanted particle intensity with respect to an unseparated beam of the same momentum range well above 5 can be obtained. (auth)

34190 THERMAL BEHAVIOR OF A BREMSSTRAHLUNG RADIATOR. Barbini, R.; Guaraldo, C.; Scrimaglio, R. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Nucl. Instrum. Methods; 123: No. 2, 259-267(15 Jan 1975).

The temperature field established throughout a bremsstrahlung radiator by a linear accelerator electron beam is studied. Various materials, thicknesses and heat loss mechanisms are taken into account with the aim of finding out the more suitable ones for a given experimental configuration. (auth)

34191 A TECHNIQUE FOR MEASURING PROTON TOTAL REACTION CROSS SECTIONS AT MEDIUM ENERGIES. Carlson, R. F.; Short, T. H. (Department of Physics, University of Redlands, Redlands, California 92373, USA); McGill, W. F.; Cameron, J. M.; Richardson, J. R.; Van Oers, W. T. H.; Verba, J. W. (California Univ., Los Angeles (USA). Dept. of Physics); Doherty, P. (Department of Physics, Loyola University, Los Angeles, California 90045, USA); Margaziotis, D. J. (Department of Physics, California State University, Los Angeles, California 90032, USA). Nucl. Instrum. Methods; 123: No. 3, 509-519(1 Feb 1975).

Total proton reaction cross sections between 20 and 50 MeV have been measured at the UCLA 50 MeV Cyclotron Laboratory. The method, a variation of the attenuation technique first proposed by Gooding and Eisberg, is described. Features include a tightly collimated and well defined beam, the ability to use either solid or gaseous targets, and rapid accumulation of the data. (auth)

34192 A REFRACTORY METAL THIN FILM EVAPORATOR FOR BACKSCATTERING STUDIES. Rollin, D. F.; Robinson, J. E. (McMaster Univ., Hamilton, Ontario (Canada). Dept. of Engineering Physics). Nucl. Instrum. Methods; 123: No. 3, 465-470(1 Feb 1975).

The design and the thin film characteristics of a refractory metal thin film evaporator-target chamber for keV ion back-

scattering studies are reported. High temperature evaporation is accomplished using a 3 kW electron beam at a background pressure of 10^{-9} to 10^{-10} torr. Vanadium films (300 to 1800 A) are analyzed using a variety of standard characterization techniques. The films are found to be relatively flat with a consistently reproducible polycrystalline B.C.C. microstructure. (auth)

34193 A HIGH-BAND NEUTRINO BEAM. Spillantini, P. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Nucl. Instrum. Methods; 123: No. 3, 421-424(1 Feb 1975).

A simple device for producing a high-band neutrino beam is proposed; it consists of a quasi-parabolic profile magnetic horn followed by a narrow circular slit. As an example, evaluations are carried out for the West Hall neutrino beam proposed at the CERN SPS for a primary proton energy $E_0 = 400$ GeV. The collimation of the resulting parent hadron beam is excellent, giving a spot of ~40 cm maximum radius at the hadron filter, with a very tenuous halo. The overall attenuation of the event rate with respect to the ideally focussed neutrino beam production is ~65%, entirely due to the partial suppression of the low energy neutrinos ($E_\nu \lesssim \frac{1}{3} E_0$). (auth)

34194 PROFILE OF A MODERN LINEAR ACCELERATOR (LINEAR ACCELERATOR SL 75/20). Voogt, F.; Atherton, L. (M.E.L. Equipment Co. Ltd., Crawley (UK)). Strahlentherapie; 148: No. 5, 502-510(Nov 1974). (In German).

From symposium on trends of modern radiotherapy; Vienna, Austria (4 May 1974).

The new Philips 20 MeV linac with print-out and verification options and the capability of automatic operation is described. An 8 MeV x-ray beam is considered as the generally useful operational mode. The electron beam energy range up to 10 MeV will cover about 40% of the electron treatments while up to 20 MeV will meet up to 90% of the requirements. The remaining 10% are probably better treated by x-rays, this proposition being supported by a number of physical and clinical reasons. The importance of high patient handling capacity is emphasized which shows the linear accelerator to be a reliable and economical "workhorse." The choice of travelling wave and 90° bending system with beam servo in the linac render an important contribution to the overall performance and stability of the equipment. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 33200, 34333, 34390, 34588, 34605, 34635, and 34871.

34195 (N-74-29235) POWERFUL GAMMA RAY SPLASHES, A NEW ASTRONOMICAL DISCOVERY. Prilutskii, O. F.; Rozental, I. L.; Usov, V. V. Translated from Priroda; No. 3, 93-95 (Mar 1974). 10p. (NASA-TT-F-15789). NTIS $4.00.

The discovery of powerful gamma ray outbursts by satellite vehicle is reported. The outbursts being determined not to originate in the Solar System, the question of the origin of these bursts is examined. (auth)

34196 (N-74-29236) FLASH-UP OF COSMIC GAMMA RADIATION FROM OBSERVATIONS ABOARD AES COSMOS 461. Mazets, E. P.; Golenetskii, S. V.; Ilinskii, V. N. Translated from Priroda; No. 3, 96-97(Mar 1974). 5p. (NASA-TT-F-15790). NTIS $4.00.

Information is presented on the outburst of gamma radiation recorded on 17 January 1972 by the Cosmos-461 satellite. The outburst is assumed to be of galactic or extragalactic origin. (auth) (STAR)

34197 STUDY OF MUONS UNDERGROUND AND THEIR ENERGY SPECTRUM AT SEA LEVEL. Wright, A. G. (Polytechnic of North London). J. Phys., A (London); 7: No. 16, 2085-2092 (1 Nov 1974).

An expression I(E, h) relating the integral intensity of muons and depth underground is presented. Particular attention is given to quantifying the various sources of uncertainty relevant to the accuracy of this expression. Measurements of sea-level intensities made with magnetic spectrographs are compared with the prediction of underground results in the energy range 5 to 1000 GeV. (auth)

34198 A PROBLEM OF EVALUATION OF ACCRETION OF EXTRATERRESTRIAL RADIOACTIVE NUCLIDES ON THE EARTH. Sitar, B. (Komenskeho Univerzita, Bratislava (Czechoslovakia). Prirodovedecka Fakulta). Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; No. 14, 127-146(Dec 1973).

Problems of evaluating the influx of radionuclides from cosmic space to the Earth are studied. The intensity, energy spectrum, and chemical composition of primary cosmic radiation are described. Nuclear reactions in space bodies are divided into spallation reactions, reactions due to secondary particles, and reactions due to "low-energy" solar particles. The dependence of the activity of space bodies on their size is studied. The influx of some radioisotopes in the process of ablation of meteoroids is evaluated. (auth)

34199 RADIOISOTOPES IN THE LITHOSPHERE. Chrapan, J.; Sitar, B. Acta Fac. Rerum Natur. Univ. Comenianae, Phys.; No. 14, 147-157(Dec 1973). (In Slovak).

Problems are surveyed of the production of radioisotopes as a result of cosmic radiation and the radioactivity of the lithosphere. Neutron flux density in the lithosphere is evaluated and the number of nuclear reactions in the atmosphere and in the lithosphere is compared. (auth)

34200 ANOMALIES IN THE COSMIC RADIATION AT TIMES OF MAGNETIC STORMS. Aldagarova, Kh. Z.; Zusmanovich, A. G.; Kolomeets, E. V.; Musabaev, M. A. (Kazakh State Univ., Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1899-1903(Sep 1974). (In Russian).

The change in the hardness of the geomagnetic cut-off was calculated for a series of Forbush decreases. The movement of the currents generated by collision waves and responsible for the Forbush decrease was examined. The moderation of the velocity of the collision waves in interplanetary medium was calculated. (tr-auth)

34201 EFFECTS OF THE SUN'S ROTATION ON THE ANISOTROPY OF COSMIC RADIATION. Shatashvili, L. Kh.; Alaniya, M. V.; Pankratov, A. K.; Stepanyan, A. A.; Pareshishvili, V. V. (Inst. of Geophysics, Tbilisi, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1904-1907(Sep 1974). (In Russian).

The 27-day changes in the diurnal and semidiurnal variation of the neutron component of cosmic radiation in the period of the IGY were studied. Trends to a 27-day repetition of the semidiurnal variation of the cosmic radiation were detected. (tr-auth)

34202 DYNAMIC CHARACTERISTICS OF SHORT-PERIOD VARIATIONS OF COSMIC RADIATION. Kozlov, V. I.; Krymskii, G. F.; Kuz'min, A. I.; Chirkov, N. P.; Filippov, A. T. (Inst. of Cosmophysics Research and Aeronomy, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1908-1911(Sep 1974). (In Russian).

Proof of the extraterrestrial origin of short-period variations in the cosmic radiation is reported. It is shown that the dynamics of the spectrum of the intensity variation are connected with perturbations in the interplanetary medium. (tr-auth)

34203 COSMIC RAY CURRENT DURING MAXIMUM AND MINIMUM SOLAR ACTIVITY. Krymskii, G. F.; Kuz'min, A. I.; Altukhov, A. M.; Krivoshapkin, P. A.; Mamrukova, V. P.; Samsonova, Z. N.; Skripin, G. V.; Chirkov, N. P. (Inst. of Cosmophysics Research and Aeronomy, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1912-1916(Sep 1974). (In Russian).

The results of an analysis of cosmic-ray currents in periods of minimum (1965) and maximum (1968) solar activity are reported. Conclusions were formed on the variability of the current structure with the cycle of solar activity. (tr-auth)

34204 ANISOTROPY OF COSMIC RAY CURRENTS IN DIFFERENT PERIODS OF SOLAR ACTIVITY. Asylbaeva, S. D.; Gonchar, G. A.; Kolomeets, E. V.; Siyunyaeva, N. V. (Kazakh State Univ., Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1917-1919(Sep 1974). (In Russian).

The partial spectrum of the variation of the diurnal anisotropy of cosmic radiation was calculated. The periodicity revealed in the changes of the anisotropic current agreed well with the period of change of the solar activity. The relation of the solar activity to the mean yearly amplitude of the anisotropy was studied. The energy spectrum of the diurnal variation from 1958 to 1970 was determined. (tr-auth)

34205 EFFECT OF SOLAR ACTIVITY ON THE SPATIAL DISTRIBUTION OF COSMIC RADIATION IN INTERPLANETARY SPACE. Dorman, L. I.; Gushchina, R. T. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1920-1923(Sep 1974). (In Russian).

A refinement and verification of the NL index are proposed. It is based on a comparison of the results of theoretical calculations of the spatial distribution of cosmic radiation in interplanetary space. (JSR)

34206 LONG-PERIOD VARIATION OF COSMIC RADIATION AND ITS NORTH-SOUTH ASYMMETRY. Bychkovskaya, A. Kh.; Kolomeets, E. V.; Mukanov, Zh. B.; Shvartsman, Ya. E. (Kazakh State Univ., Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1924-1927(Sep 1974). (In Russian).

The partial spectrum of the variations of the cosmic ray intensity and solar activity was studied in the interval from 0.025 to 0.0002 per day. Changes in the tidal forces and Sun's acceleration under the influence of the inner planets of the solar system were also studied. The north-south asymmetries in the cosmic-ray intensity and the solar activity were also studied. (tr-auth)

34207 YEARLY VARIATION OF THE COSMIC RADIATION FROM 1958 TO 1968. Dorman, L. I.; Milovidova, N. P. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1928-1931(Sep 1974). (In Russian).

The yearly variation of the cosmic radiation was calculated theoretically and the results were compared with the measured changes in the solar activity with the Sun's latitude from 1958 to 1968. The equation derived gives the distribution of the density of galactic cosmic radiation close to the Sun's equator that is close to the measured values. (JSR)

34208 MODULATION OF COSMIC RADIATION IN DIFFERENT PERIODS OF SOLAR ACTIVITY. Ashirov, R. R.; Zusmanovich, A. G.; Kolomeets, E. V. (Kazakh State Univ., Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1932-1936(Sep 1974). (In Russian).

The values of the modulation coefficients of galactic cosmic radiation were determined for the period from 1957 to 1972. Data were reported on the radial gradients of the cosmic radiation intensity at different distances from the Sun. From the data on the modulation coefficients and the gradient it was concluded that the dimension of the region of modulation was 5 to 6 AU in 1972. (tr-auth)

34209 ENERGY SPECTRUM OF THE 11-YEAR VARIATION OF COSMIC RADIATION IN THE 0.5 TO 10 GV HARDNESS REGION IN THE PERIOD OF THE 19TH AND 20TH CYCLES OF SOLAR ACTIVITY. Svirzhevskaya, A. K.; Stozhkov, Yu. I.; Charakhch'yan,

T. N. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1937-1941(Sep 1974). (In Russian).

The relative changes in the intensity of primary cosmic radiation were studied as a function of the particle hardness for different levels of solar activity of the 19th and 20th cycles. The studies were based on data from the measurement of the total and vertical currents of cosmic radiation at different stratospheric depths. (tr-auth)

34210 PARAMETERS OF THE VARIATION OF COSMIC RADIATION DETERMINED BY THE SPECTROGRAPHIC METHOD. Dorman, L. I.; Dvornikov, V. M.; Luzov, A. A.; Sergeev, A. V.; Yanchukovskii, A. L. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1942-1945(Sep 1974). (In Russian).

The Forbush effect in cosmic radiation, recorded by a spectrograph in Irkutsk, was analyzed. From the data on the change of the hardness of the geomagnetic cut-off and the effect of the depression of the geomagnetic field, the parameters of the ring current were evaluated. The spectra of the cosmic radiation modulation for the Forbush effect were determined. (tr-auth)

34211 STUDY OF THE 11-YEAR VARIATION OF COSMIC RADIATION BY THE SPECTROGRAPHIC METHOD. Dorman, I. V.; Dorman, L. I.; Dvornikov, V. M.; Sergeev, A. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1946-1950 (Sep 1974). (In Russian).

The energy spectrum of the 11-year variation was determined by the spectrographic method on the basis of observation data in the stratosphere. A decrease of the modulation of the low-energy galactic cosmic radiation was detected. The results obtained were interpreted on the basis of the theory of the interaction of particles with the inhomogeneities of the interplanetary magnetic field. (tr-auth)

34212 INDEX OF SOLAR ACTIVITY CONTROLLING THE VARIATION OF COSMIC RADIATION. Dorman, L. I.; Pimenov, I. A.; Churunova, L. F. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1951-1956(Sep 1974). (In Russian).

For a detailed analysis of the relation between the heliolatitude index and the cosmic radiation intensity, the coefficients of mutual correlation of the HL index were calculated for the period of increase (1954 to 1957), a period of the maximum (1958 to 1960), and the period of decrease (1971 to 1965) of the solar activity as a function of the time displacement. A comparison of the results obtained for the three periods led to the conclusion that in the period of decrease of solar activity two regions of modulation are clearly evident and that the dimension of the outer region of modulation increases 2 to 3 times in comparison with the dimensions of the inner modulation region in the period of decrease of solar activity. (JSR)

34213 METHOD FOR THE DETERMINATION OF THE BAROMETRIC COEFFICIENT OF THE NEUTRON COMPONENT. Dorman, L. I.; Pimenov, I. A.; Seregina, M. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1957-1960(Sep 1974). (In Russian).

A method is proposed for the practical determination of the barometric coefficient which takes into consideration the changes in the primary spectrum, the hardness of the cut-off, and the pressure at the observation level. The method is based on the simultaneous measurement of the cosmic radiation intensity and the pressure at two recording points. (JSR)

34214 FLUCTUATION PHENOMENA DURING THE PROPAGATION OF COSMIC RADIATION IN INTERPLANETARY SPACE. Dorman, L. I.; Kats, S. E. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1961-1965(Sep 1974). (In Russian).

Expressions for the correlation functions of cosmic radiation were derived on the basis of kinetic equations for the case $R \ll L_c$ (where R is the Larmor radius of the particles in regular magnetic fields and L_c is the correlation radius of random magnetic fields. The expressions were used to make an evaluation of the mean square of random magnetic fields in interplanetary space and the characteristic dimension of the inhomogeneities of the magnetic fields. (JSR)

34215 DETECTION OF SYNCHRONOUS CHANGES OF THE CURRENTS OF HIGH ENERGY ELECTRONS AND GAMMA QUANTA DURING MAGNETIC PERTURBATIONS. Voronov, S. A.; Gal'per, A. M.; Kirillov-Ugryumov, V. G.; Kurochkin, A. V.; Leikov, N. G.; Luchkov, B. I.; Fesenko, A. I.; Yurkin, Yu. T. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1966-1969(Sep 1974). (In Russian).

The results obtained on a high-altitude balloon flight on October 12, 1972, with a γ telescope and an electron spectrometer with spark chambers were reported. It was established that the intensity of γ quanta with $E > 40$ MeV and electrons with $E > 100$ MeV undergo significant time variations. An increase of the negative excess in the electron component during magnetic perturbations was detected. (tr-auth)

34216 LATITUDE STUDY OF COSMIC RADIATION. Blokh, Ya. L.; Dorman, L. I.; Dorman, I. V.; Bednazhevskii, V. M.; Viskov, V. V.; Manshilina, A. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1970-1973(Sep 1974). (In Russian).

The coupling coefficients of cosmic radiation were experimentally determined from data of latitude measurements made on a scientific research ship from 1967 to 1971 and from data measured in Argentina in 1964 and 1969. The experimental results obtained were compared with theoretical calculations of the coupling coefficients for different indices of the primary radiation spectra. The integral generation multiplicity and the 11-year variation spectrum were also determined. (JSR)

34217 HIGH-ALTITUDE MEASUREMENTS OF THE INTENSITY OF THE SOFT AND HARD COMPONENTS OF COSMIC RADIATION AND OF THE BAROMETRIC COEFFICIENTS. Blokh, Ya. L.; Dorman, L. I.; Dorman, I. V.; Libin, I. Ya. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1974-1977 (Sep 1974). (In Russian).

The results of the high-altitude measurements of the altitude variation of the total cosmic radiation intensity and the intensity of the hard and soft components, the altitude variation of the barometric coefficient for the total, soft, and hard cosmic radiation, and the angular distribution of the barometric coefficients are reported. (JSR)

34218 CALCULATIONS OF THE INTEGRAL MULTIPLICITY AND COUPLING COEFFICIENTS. Viskov, V. V.; Dorman, L. I.; Yanke, V. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1978-1981(Sep 1974). (In Russian).

The results of the calculation of the coupling coefficients of the neutron and meson components of cosmic radiation are reported. The coupling coefficients for the meson component was obtained at different underground depths. The calculation of the nuclear cascade in the atmosphere was made by the statistical sampling method with consideration of experimental data on the distribution of the basic characteristics of elementary interactions. (tr-auth)

34219 SOME CRITERIA OF THE QUALITY OF MEASUREMENT OF A MULTICHANNEL NEUTRON SUPERMONITOR. Kudela, K. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1982-1986 (Sep 1974). (In Russian).

Methods for the verification of the quality of data obtained by a multichannel neutron supermonitor are reported. Assumptions on the normalization of the distribution of errors of quadrupole measurements, the equivalence of light velocity levels, and the equivalence of difference dispersions obtained by the combination of the readings of the individual sections were verified. The values obtained as a result of these tests (significance level) describe the stability and equal accuracy of measurements and characterize the measurements of all sections simultaneously. (tr-auth)

34220 ATMOSPHERIC EFFECTS IN THE VARIATION OF COSMIC RADIATION AT AN ALTITUDE OF 3200 M ABOVE SEA LEVEL. Akopyan, S. K.; Babayan, Kh. P. (Inst. of Physics, Erevan). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1987-1989 (Sep 1974). (In Russian).

The calculations of meteorological effects in the variations of cosmic radiation at an altitude of 3200 m are reported. The value $\beta = -0.743\%$/mbar was obtained for the barometric coefficient of the neutron component and $\beta = -0.136\%$/mbar for the meson component. (tr-auth)

34221 ENERGY SPECTRA OF THE SECONDARY ELECTRON CURRENT AT DIFFERENT ATMOSPHERIC DEPTHS. Gal'per, A. M.; Luchkov, B. I.; Prokhorova, L. A. (Moscow Engineering-Physics Inst.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1990-1992(Sep 1974). (In Russian).

The differential energy spectra of electrons were obtained at different atmospheric depths. The calculations were made under the assumption that in the energy region examined the spectrum has a piecewise power form with the power exponents α_1 and α_2. It is shown that the dependences of α_1 and α_2 on atmospheric depth are quite different. (tr-auth)

34222 INSTALLATION FOR THE IDENTIFICATION OF HADRONS WITH ENERGY ≥300 GeV BY MEANS OF TRANSITION RADIATION. Alikhanyan, A. I.; Avakyan, V. V.; Avakyan, K. S.

(Inst. of Physics, Erevan). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1993-1995(Sep 1974). (In Russian).

An installation is described for the identification of hadrons of cosmic radiation with energy ≥300 GeV. It consists of a scintillation calorimeter, a spark chamber, and transition radiation detector. (tr-auth)

34223 SOME CHARACTERISTICS OF THE STUDY OF MUON SPECTRA ON INSTALLATIONS OF THE IONIZATION-CALORIMETER TYPE. Kokoulin, R. P.; Pavlov, A. A.; Petrukhin, A. A.; Shestakov, V. V. (Moscow Engineering-Physics Inst.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1996-2000(Sep 1974). (In Russian).

Experimental data obtained with the ionization calorimeter MIFI were used to analyze the characteristics of the installation. The evaluation of the cascade energy, generation of cascades outside the calorimeter, and the effect of the finite transverse dimensions of the installation are discussed. (JSR)

34224 MEASUREMENT OF COSMIC RADIATION ON BOARD THE MARS-2. Vernov, S. N.; Tverskoi, B. A.; Yakovlev, V. A. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1859-1862(Sep 1974). (In Russian).

Data obtained on the Mars-2 on the intensity of cosmic radiation from May 20, 1971, to November 26, 1971, are reported. (tr-auth)

34225 ANISOTROPY AND TIME CHANGE OF THE SPECTRUM OF THE COSMIC RADIATION INTENSITY VARIATION IN AUGUST 1972. Belov, A. V.; Blokh, Ya. L.; Dorman, L. I.; Eroshenko, E. A.; Inozemtseva, O. N.; Kaminer, N. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1867-1875(Sep 1974). (In Russian).

From the data of the world network of neutron monitors, the variation of the cosmic radiation August 3-10, 1972, was studied. Variations of the density and current of cosmic radiation in the region near the Earth were found. The characteristics of the phenomenon in the cosmic radiation, primarily the Forbush effect, were examined. Conclusions were formed on the properties of interplanetary space in this period. (tr-auth)

34226 ENERGY AND PROPAGATION CHARACTERISTICS OF THE PHENOMENON IN COSMIC RADIATION IN AUGUST 1972. Altukhov, A. M.; Krymskii, G. F.; Kuz'min, A. I.; Samsonov, I. S.; Samsonova, Z. N.; Skripin, G. V.; Filippov, V. A.; Chirkov, N. P.; Shafer, G. V. (Inst. of Cosmic Radiation Research and Aeronomy, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1876-1879 (Sep 1974). (In Russian).

The complex sequence of events in the cosmic radiation of August 1972 offers valuable new experimental material for obtaining new knowledge on the mechanism for the modulation of cosmic radiation by solar wind. The behavior of the cosmic radiation current in this period was analyzed. An attempt was made to interpret some properties of the phenomenon and correlate them with effects on the Sun. (JSR)

34227 PRELIMINARY RESULTS OF THE STUDY OF THE EFFECT OF THE INCREASE OF COSMIC RADIATION FROM THE FLARE OF DECEMBER 10, 1966. Dorman, L. I.; Kaminer, N. S.; Kuz'micheva, A. E.; Okulov, Yu. I.; Khadakhanova, T. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1880-1883 (Sep 1974). (In Russian).

Data from the network of neutron monitors from December 9-13, 1966, were used to analyze the effect of the increase of cosmic radiation. The spatial change of the amplitude of the effect of the cosmic radiation intensity increase was calculated for different moments of time. The expected intensity increase for different asymptotic latitudes and different moments of time was calculated on the basis of data on the form of the collision wave front and the distribution of the magnetic field in interplanetary space and the results were compared with experimental data. The experimental boundary effect of the increase qualitatively agrees with the theoretical calculations. (JSR)

34228 SOME QUESTIONS OF THE THEORY OF THE EFFECT OF THE INCREASE OF INTENSITY OF COSMIC RADIATION BY THE FORBUSH DECREASE. Shakhov, B. A.; Dorman, L. I.; Belov, A. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1884-1887(Sep 1974). In Russian).

The effect of different forms of magnetic shields and different conditions for the propagation of particles through the shield on the increase of the intensity of cosmic radiation in the presence of the Forbush effect was studied. The conditions for stationarity of the effect were determined. It is shown that the degree of anisotropy of the effect of increase can be used as an indicator of the condition of interplanetary space. (tr-auth)

34229 EFFECTS OF COLLISION WAVES IN THE KINETICS OF COSMIC RADIATION. Dorman, L. I.; Shogenov, V. Kh. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1888-1894(Sep 1974). (In Russian).

A kinetic equation of the movement of charged particles in a random magnetic field with consideration of the collision waves was obtained. Under the condition that the leading front of strong collision waves are mirror-image surfaces, the amplitude of the increase of the intensity of cosmic radiation was found. (tr-auth)

34230 ASTROPHYSICAL LIMITATIONS ON THE NEUTRINO-NUCLEON CROSS SECTION AT ENERGIES $E \geq 3 \times 10^{17}$ eV. Berezinskii, V. S.; Smirnov, A. Yu. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1834-1837(Sep 1974). (In Russian).

The integral neutrino spectra generated by protons from normal galaxies, spectra from evolving sources such as radiogalaxies or quasars, spectra of galactic neutrinos in the direction of the galactic center, and vertical spectra of atmospheric neutrinos were calculated by methods described previously. The spectra obtained are discussed. The possibility of recording high-energy neutrinos in extensive air showers and the effects of the muon component, and background created by the muon shower on the recording of neutrinos are evaluated. The results for the upper detection limit are tabulated. (JSR)

34231 GAMMA TELESCOPE EXPERIMENT (PRELIMINARY RESULTS). Belyaevskii, A. I.; Bokov, V. L.; Bocharkin, V. K. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1838-1841(Sep 1974). (In Russian).

The installation is described and the basic characteristics of the gamma telescope with acoustical spark chamber ($E \geq 100$ MeV) are reported. Preliminary data obtained during its flight on the Cosmos-561 are outlined. (tr-auth)

34232 METAGALACTIC PROTONS OF SUPERHIGH ENERGY. Berezinskii, V. S.; Grigor'eva, S. I.; Zatsepin, G. T. (Inst. of Nuclear Research, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1791-1795(Sep 1974). (In Russian).

The possibility of the transition from galactic radiation to metagalactic is analyzed. The energy loss of protons in electromagnetic radiation in the metagalaxy and the change of the proton energy with time are examined. Cosmic protons of superhigh energy from normal galaxies are analyzed. (JSR)

34233 DEPENDENCE OF THE DIFFUSION OF GALACTIC COSMIC RADIATION ON ENERGY. Bulanov, S. V.; Dogel, V. A.; Ptuskin, V. S. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1796-1800(Sep 1974). (In Russian).

The limitations placed on the value of the constant μ, determined from different data on cosmic radiation on the Earth and data on nonthermal galactic radio sources, were evaluated. (JSR)

34234 PRIMARY COSMIC RADIATION ON THE SURFACE OF THE MOON. Lavrukhina, A. K.; Gorin, V. D.; Kashkarov, L. L.; Ustinova, G. K. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1806-1810 (Sep 1974). (In Russian).

Measurement of the activity of cosmogenic isotopes ^{26}Al and ^{22}Na in samples of lunar soil obtained by Luna-16 and Luna-20 showed the constancy of a medium flux of galactic and solar cosmic radiation for the last 10^6 years. The study of tracks in lunar minerals showed that constancy of the intensity of the heavy components of solar cosmic radiation ($23 \leq Z \leq 28$) for the last (4 to 5) $\times$ 10^8 years. (tr-auth)

34235 CONTENT OF THE ISOTOPES ^{12}C AND ^{13}C IN PRIMARY COSMIC RADIATION. Bogdanov, S. D.; Ostroumov, V. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1811-1812(Sep 1974). (In Russian).

The masses of C nuclei stopped in an emulsion chamber were measured. The determination of the masses was done by measurement of the area of the track projection at different parts of the track with residual free path from 1 to 15 mm. The ratio $^{13}C/(^{12}C + ^{13}C) = 0.12 \pm 0.09$ was obtained. (tr-auth)

34236 INTENSITY AND SPECTRUM OF THE ELECTRON COMPONENT OF COSMIC RADIATION. Karakad'ko, V. K.; Romanov, V. A. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1816-1819(Sep 1974). (In Russian).

An electron current with $E > 0.35$ GeV was measured in 1972 in the upper regions of the atmosphere with a telescope consisting of a shower spark chamber, scintillation counters, and an oriented gaseous Cherenkov counter. The secondary electron spectrum, averaged over the height interval from 10 to 20 km, and the electron spectrum at a height of 31 km are given. (tr-auth)

34237 EVALUATION OF THE RATIO ^{3}He/(^{3}He + ^{4}He) IN PRIMARY COSMIC RADIATION FOR ENERGY ~1 GeV/NUCLEON.

Iodko, M. G.; Romanov, V. A. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1813-1815(Sep 1974). (In Russian).

A telescope consisting of scintillation counters, oriented Cherenkov counters with organic glass radiators, and two gaseous Cherenkov counters measured the ratio $^3He/(^3He + ^4He)$ in the energy range E > 1.5 GeV/N. A value of 0.2 ± 0.08 was obtained. (tr-auth)

34238 COSMO- AND GEOCHRONOLOGY. Gopalan, K.; Rao, M. N. (Tata Inst. of Fundamental Research, Bombay (India)). Phys. News (India); 4: No. 4, 78-83(Dec 1973).

Some simple dating techniques applied in cosmo and geochronology are described. The K/Ar method is found to be suitable for rocks around the age 10^5 years, and also in paleomagnetic studies. The Rb/Sr and U/Pb isotope techniques are extensively applied for time correlation of rock systems over local and global scales. Fission track dating method is particularly suitable for young rocks not datable easily by isotope growth methods. Studies on geochronology have been very useful in verifying theories on continental drifts and sea floor spreading. Isotope dating techniques have also been applied to the dating of meteorites and the moon. The ages revealed form the basis of any theory of planetary evolution. The formation interval of meteorites has also been determined by studying the ^{129}Xe content in the meteorites and attributing it to the extinct radionuclide ^{129}I. (INIS)

34239 COSMIC-RAY STOERMER CUT-OFFS ON THE SURFACE OF JUPITER. Cooke, D. J. (Univ. of Tasmania, Hobart, Australia). Proc. Astron. Soc. Aust.; 2: No. 5, 296-297(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

It has been suggested that Jupiter may be responsible for a modulation component in the counting rate of underground cosmic ray detectors on Earth. The evidence suggests that a screening mechanism is operating, in as much as the observed counting rates are diminished when Jupiter is within the field of view of these detectors. The magnitude of the effect is larger than can be accounted for by simple line-of-sight obscuration by the planet itself, and it has been suggested that the intense and extensive Jovian magnetic field is producing the effect. Störmer theory is used to consider the effect of an axially symmetric magnetic field on the cosmic ray flux and from the results it is concluded that the magnetic field of Jupiter could not by means of "normal" particle deflection mechanisms, be responsible for the reported anisotropy in primary radiation. (AUS)

34240 COSMIC-RAY ENERGY CHANGES. Gleeson, L. J. (Monash Univ., Clayton, Australia); Webb, G. M. Proc. Astron. Soc. Aust.; 2: No. 5, 297-299(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

The purpose of this paper is to provide a new expression for $\langle \dot{p} \rangle$ the average time-rate-of-change of momentum of cosmic-ray particles propagating in the interplanetary region. The expression derived replaces the previously used adiabatic deceleration formula and it is arrived at by a rearrangement and reinterpretation of the well known equation of transport for cosmic-rays. Thus, although a new expression for $\langle \dot{p} \rangle$ is obtained the equation of transport is maintained and does not render invalid results for differential intensity and differential current density of cosmic-ray particles obtained by its solution. (AUS)

34241 SOLUTIONS OF THE COSMIC-RAY EQUATION OF TRANSPORT. Webb, G. M. (Univ. of Tasmania, Hobart, Australia); Gleeson, L. J. Proc. Astron. Soc. Aust.; 2: No. 5, 299-302(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

A study was made of the steady-state interplanetary propagation of solar cosmic-rays by means of analytic solutions of the equation of transport. The cosmic-rays are released monoenergetically from a fixed heliocentric radius and redistribute in energy as they propagate. The analytic solutions of Gleeson and Webb are used to show the energy changes, the redistribution in energy (or momentum) and the characteristics of the particle flow or streaming. The steady-state spherically symmetric solutions of the cosmic-ray equation of transport show the momentum spectra of the distribution function Fo, the momentum number density Up and the streaming Sp or monoenergetic solar cosmic-rays vary with heliocentric distance, source momentum Po and diffusion coefficient K(r,p). In particular, it is shown that: (i) particles of lower momentum Po lose a larger fraction of their critical momentum; (ii) the spectra Fo, Up, and Sp are principally determined by the radial dependence of the diffusion coefficient. (AUS)

34242 SIDEREAL COSMIC-RAY VARIATIONS OBSERVED DEEP UNDERGROUND. Fenton, A. G.; Fenton, K. B. (Univ. of Tasmania, Hobart, Australia). Proc. Astron. Soc. Aust.; 2: No. 5, 302-304(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

The search for a galactic cosmic-ray anisotropy of the order of 0.1% has been in progress for the past decade by the cosmic-ray research group. A pilot experiment was commenced during the latter half of 1971 at an underground hydro-electric commission power station at Poatina, about 130 km north of Hobart. The equipment is located at 150 metres, or 400 m.w.e., below the surface so that the minimum energy for the muons to penetrate to the detectors is 10^{11} eV, corresponding to a median energy for primary cosmic rays in the range 2 to 7×10^{11} eV. At these energies the influence of the solar wind on the rays approaching the Earth should be much reduced and the sidereal anisotropy more readily distinguished from other effects. The evidence for sidereal daily variations is examined. (AUS)

34243 EFFECT OF THE MUON CONTRIBUTION ON THE BAROMETRIC COEFFICIENT OF NEUTRON MONITORS. Quang, T. T.; Fenton, A. G.; Fenton, K. B. (Univ. of Tasmania, Hobart, Australia). Proc. Astron. Soc. Aust.; 2: No. 5, 304-305(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

This paper presents some results obtained with a low-multiplicity neutron monitor employing SiO_2 as reflector, moderator, and producer. It consists of a 1.05 m × 1.60 m × 2.76 m concrete brick stack containing two large Chalk River (BP28) BF_3 counters, spaced 46 cm apart, yielding an average count rate near sea level of ~9000 c/hr per counter. The contribution made by low-energy neutrons from the surroundings to the counting rate of the neutron monitor is ~0.5%. The contribution of the atmospheric multiple neutron production to the total multiple neutron production observed in the monitor is small (~0.25%), thus causing a negligible effect on the various multiplicity-associated factors such as barometric coefficients, response functions and statistics of observed counting rates. An equation was used to estimate the contribution to the counting rate of the concrete monitor made by the muon component. It was found that 1.77% and 0.4% of the total counting rate of the concrete monitor are due to the contributions from stopping negative muons and fast muons respectively. This stopping muon contribution of 1.77% is to be compared with 4.4% and 3.6% in the Leeds IGY and NM64 monitors obtained by Hatton (1971) and ~7% in the IGY monitor by Hughes and Marsden (1966). Neutron data collected by the concrete monitor from October 1972 to December 1973 have yielded a barometric coefficient at sea level of 0.988 ± 0.013%/mm Hg (for 1972) and 0.978 ± 0.005%/mm Hg (for 1973), determined by the regression method of Bachelet et al. (1965). The corresponding values of the barometric coefficient for the Hobart IGY monitor are 0.981 ± 0.013%/ mm Hg (1972) and 0.988 ± 0.006%/mm Hg (1973). Thus on average, the concrete and the IGY monitors have the same yearly barometric coefficient within the statistical error, at sea level and cut-off rigidity of 1.89 GeV. Their values were also found to be in fair agreement with that of ~0.990%/mm Hg measured at sea level with a 3NM64 monitor at the same cut-off rigidity (~2 GeV) in 1965 (Carmichael and Bercovitch 1969). (AUS)

34244 COSMIC-RAY PARTICLE DIFFUSION AND THE FOKKER–PLANCK EQUATION. Urch, I. H. (Waikato Univ., Hamilton, New Zealand). Proc. Astron. Soc. Aust.; 2: No. 5, 306-307(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

The transport of charged particles in random electro-magnetic fields is investigated and it is shown that under certain general conditions a Fokker–Planck equation is valid, but these equations are not satisfied by the interplanetary magnetic field fluctuations. (AUS)

34245 MODULATION OF COSMIC-RAY INTENSITY UNDERGROUND ASSOCIATED WITH THE PLANET JUPITER. Jacklyn, R. M. (Dept. of Science, Melbourne); Cini-Castagnoli, G. Proc. Astron. Soc. Aust.; 2: No. 5, 293-295(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

Underground meson data was analyzed in Jovian time for any evidence that Jupiter may be modulating the intensity of cosmic radiation at higher energies over a complete orbital period. Observations were carried out with a vertically directed Geiger counter telescopes at the Hobart underground site from July 1957. Pressure-corrected bi-hourly values of meson intensity were analyzed for the 12 year period from January 1958 to December 1969. (AUS)

34246 FLUXES AND ENERGY SPECTRA OF ELECTRONS AND GAMMA QUANTA WITH AN ENERGY GREATER THAN 100 MeV IN THE UPPER LAYERS OF THE ATMOSPHERE. Gal'per, A. M.; Prokhorova, L. A. (Moscow Engineering-Physics Inst.). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 175-180 (1974).

Translated from Geomagn. Aeron.; 14: No. 2, 207-213(1974).

The intensities and energy spectra of secondary electron and γ-quantum fluxes appearing in the atmosphere under the effect of cosmic rays are computed. The computations are performed for $\varphi = 46°$, a depth of the atmosphere of 0 to 40 g/cm^2, and secondary particle energies greater than 100 MeV. A comparison of the computed with the experimental values indicates the existence of an additional electron flux arriving from beyond the boundary of the atmosphere. (auth)

34247 ABSOLUTE SEA LEVEL MUON SPECTRUM NEAR EQUATOR IN THE MOMENTUM RANGE 0.32-3 GeV/c. Bhattacharyya, D. P. (Indian Association for Cultivation of Science, Calcutta). J. Phys. Soc. Jap.; 37: No. 2, 293-298(Aug 1974).

A study has been made on the differential spectrum of single muons near the geomagnetic equator (12°N) in the momentum range 0.32-3 GeV/c by using the differential range spectrograph results. The corrected experimental spectrum has been compared with those of other workers determined at low and high latitudes. The present results agree with the theoretical spectra calculated after Barrett et al. and Olbert for the same location within 10% above muon momentum 1 GeV/c. The corrections for the geomagnetic and atmospheric latitude effects have been applied to our low latitude spectrum by using the theory of Olbert and Jabs to explain the deviation of the Kiel muon spectrum of Allkofer and Knoblich from ours. (auth)

34248 KINETICS OF COSMIC PARTICLES IN FRONT OF A MOVING MAGNETIC MIRROR. II. Dorman, L. I.; Shogenov, V. K. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 296-298(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 355-356(1974).

The reflection of cosmic-ray particles from the leading edge of a shock wave ("magnetic mirror") was examined previously by the authors (1973). General formulas for the distribution of reflected particles were obtained on the assumption of specular reflection. In this note equations are obtained for determining the energy spectrum for diffuse reflection. (WDM)

34249 SPECTRUM OF FORBUSH DECREASES IN THE REGION OF HIGH ENERGIES. Bishara, A. A.; Dorman, L. I. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 298-301(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 357-359(1974).

The method of relations, described by Bishara and Dorman [Geomagn. i aeronomiya, 1973, 13, 782] is used to determine the spectrum of Forbush decreases in the region of high energies by means of coupling constants. (MHR)

Stars

Refer also to abstracts 34600, 34661, and 34668.

34250 (AD-786780) CATALOG OF 10-MICROMETER CELESTIAL OBJECTS. Hall, R. T. (Aerospace Corp., El Segundo, Calif. (USA)). 15 Sep 1974. Contract F04701-74-C-0075. 143p. (SAMSO-TR-74-212). NTIS $5.75.

This catalog is a compilation of observations of 647 celestial objects reported in 97 articles in the open literature with measured infrared emissions at or near 10 micrometers. The source name, the equatorial and galactic coordinates, and the infrared flux of each object are given. This catalog is a revision of a catalog of 383 10-micrometers objects published in 1972. (auth)

34251 (ORO-4028-0021, pp 84-86) NUCLEOSYNTHESIS OF Li, Be, AND B BY REACTIONS OF INTERMEDIATE-ENERGY PROTONS ON C, N, AND O. Roche, C. T.; Clark, R. G.; Mathews, G. J.; Viola, V. E. Jr. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34252 VARIABLE STARS IN GLOBULAR CLUSTERS AND IN RELATED SYSTEMS. Proceedings of the Twenty-First Colloquium, Toronto, Canada, August 29-31, 1972. Fernie, J. D. (ed.). Astrophysics and Space Science Library, Volume 36. Dordrecht, Netherlands; D. Reidel Publishing Co. (1973). 240p. $26.55.

From proceedings of the twenty-first colloquium; Toronto, Can. (29 Aug 1972).

The papers deal with observational and theoretical aspects of the problem of variable stars, including the relationship between variables and nonvariable members of clusters, the position of the variables in the HR diagram, and their importance for problems of stellar evolution. Empirical data on the variables, the periods and period changes, and the relevant parts of pulsation theory are examined. (IAA)

34253 SPECTRAL CLASSIFICATION AND MULTI-COLOR PHOTOMETRY. IAU Symposium No. 50. Dordrecht, Netherlands; D. Reidel Publishing Co. (1973). vp.

Two hundred giant and subgiant stars near KO were classified twice by somewhat different techniques. The resulting types were in excellent agreement but a comparison of the assigned types with U, B, V colors indicated both an intrinsic scatter in the colors for stars of similar spectroscopic appearance and a problem in either the luminosity classifications or the standard colors or both. Several peculiar stars and a luminous supergiant were also detected. (IAA)

34254 EXTERIOR SOLUTION FOR A CHARGED RADIATING SPHERE IN GENERAL RELATIVITY. Krori, K. D.; Barua, J. (Cotton Coll., Gauhati, India). J. Phys., A (London); 7: No. 17, 2125-2129(21 Nov 1974).

The exterior solution for a radiating sphere in general relativity is known. The complete exterior solution, when the radiating sphere is charged, is presented here. (auth)

34255 PULSATING STARS. Cox, J. P. (Joint Inst. for Laboratory Astrophysics, Boulder, CO). Rep. Progr. Phys.; 37: 563-698(1974).

Pulsating stars are a subset of the class of intrinsic variable stars. In this review the main emphasis is on purely radial pulsations of spherically symmetric, nonrotating, nonmagnetic stars. Most of the problems in this area can be treated on the basis of Newtonian mechanics and gravitation. However, some modifications introduced by general relativity are described. (WDM)

34256 FAR ULTRAVIOLET SPECTRUM OF β LYRAE. Hack, M. (Astronomical Observatory of Trieste, Italy). Astron. Astrophys.; 36: No. 2, 321-323(Nov 1974).

The ultraviolet spectrum of β Lyrae observed with the S 2/68 experiment aboard the TD 1 satellite has been compared with the spectra of several standard stars and with theoretical models. These results, together with those obtained by Copernicus telescope (OAO-3) show that the spectrum of β Lyrae is characterized by strong emission lines at $\lambda \lesssim 2300$ Å and by absorption lines at $\lambda > 2300$ Å. The energy distribution is similar to that of a B 8 star, and the effective temperature of the models which best fit the observed energy curve is T = 11,000K. (auth)

34257 APERTURE SYNTHESIS OF FORMALDEHYDE ABSORPTION IN Sgr A. Whiteoak, J. B. (Commonwealth Scientific and Industrial Research Organization, Sydney); Rogstad, D. H.; Lockhart, I. A. Astron. Astrophys.; 36: No. 2, 245-251 (Nov 1974).

Synthesis observations of the 4830 MHz formaldehyde absorption originating near Sgr A are presented. The synthesized beamwidth is 20 arcsec in right ascension and 40 arcsec in declination. The velocity resolution is 6.2 km s^{-1}. The results suggest that the broad +40 km s^{-1} absorption feature arises in two separate dense molecular clouds behind, and moving away from, the center of the Galaxy. (auth)

34258 ANOMALOUS REDSHIFTS IN BINARY STARS. Crowley, A. P.; Hutchings, J. B. (Dominion Astrophysical Observatory, Victoria, British Columbia). Astron. Astrophys.; 36: No. 2, 305-306(Nov 1974).

Evidence is presented that some of the "anomalous" redshifts of the He II, λ 4686, line in Wolf-Rayet binaries are due to systematic errors of measurement. (auth)

34259 CATACLYSMIC VARIABLES AND γ-RAY OUTBURSTS. Vidal, N. V.; Wickramasinghe, D. T. (Australian National Univ., Canberra). Astron. Astrophys.; 36: No. 2, 309-310(Nov 1974).

A number of cataclysmic variables are found within the error boxes of γ-ray outbursts. The flickering time scale of a superhot spot on the disk surrounding the primary may explain the fine structure of the γ-ray outbursts. (auth)

34260 HISTORY OF CEN X-3. Meyer-Hofmeister, E. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Astron. Astrophys.; 36: No. 2, 261-265(Nov 1974).

It is assumed that the X-ray binary Cen X-3 has evolved from an initial system of which one component was a massive star through a phase of mass transfer and a following supernova explosion. What possible initial systems lead to an evolved system of which the masses are in agreement with the mass function of Cen X-3 are investigated. For a complete sample of initial con-

figurations a lower limit of 3 days is found for the final periods. Since the observed period of Cen X-3 is 2.087 days it is concluded that further mass loss has taken place. Maximal and minimal rates of mass loss are derived. (auth)

34261 SPECTROPHOTOMETRIC RESULTS FROM THE COPERNICUS SATELLITE. The Ultraviolet Spectrum of α And. Stalio, R. (Astronomical Observatory of Trieste, Italy). Astron. Astrophys.; 36: No. 2, 279-294(Nov 1974).

A list of lines identified in the Copernicus spectrum scans of the manganese star α And is presented for selected regions in the far (λ < 2000 Å) and near (λ > 2000 Å) ultraviolet. Equivalent widths and central intensities have been calculated. The continua have been drawn with careful selection of the windows and using the spectra of α Lyr and of the supergiant star β Ori. A comparison with some properties of the visible spectrum of α And has been made and an estimate given of the strength of the resonance line of B II at λ 1362.46 Å. (auth)

34262 PHOTOSPHERES OF NOVAE. Nariai, K. (Observatory, Nice). Astron. Astrophys.; 36: No. 2, 231-236(Nov 1974). (In French).

The position of the photosphere of the circumstellar envelope of a nova is determined. It is shown that hydrodynamical processes work only in the first phase of the explosion. After that phase, the accelerating mechanisms are the gravitational force of the central star and radiation pressure, but the effect of the latter is found to be smaller than that of the former. Therefore, a density distribution in the envelope is obtained assuming that gravitation is the only force acting for the case of zero spin angular momentum. The solution of the equation of motion is given in a normalized form appropriate to the analysis of the present study. Assuming that the cooling of the gas outside the photosphere is adiabatic, that the luminosity is constant, and that the opacity k is represented by $k = k_0\rho^{\alpha}T^{\beta}$, the position of the photosphere is obtained as a function of time. When the radius of the photosphere is large and the effective temperature is low, hydrogen is not ionized in the photosphere and we obtain $r_{photo} = r_0 t^{-0.7}$ This phase corresponds to the early photometric decline, i.e. between the maximum and the transition phase of a nova. It is the strong positive correlation between k and T (β = 7) which stabilizes the position of the photosphere in spite of the large decrease in density. As the photosphere moves inward, the effective temperature increases and hydrogen begins to ionize at the photosphere. At this phase, the radius of the photosphere decreases very rapidly because the stabilizing mechanism no longer works. As the radius of the photosphere depends very sensitively on density during this phase, it is possible that small fluctuations in density can cause light variations which might be interpreted as radial oscillations. After the transition phase, the moving envelope is optically thin in the continuous spectrum, and the surface of the envelope is seen in quasi-static contraction (Nariai, 1973, 1974). The light curve at a specific wavelength can be obtained via the bolometric correction. (auth)

34263 NEW OH SOURCES AT 1612 MHz. Kerr, F. J.; Bowers, P. F. (Univ. of Maryland, College Park). Astron. Astrophys.; 36: No. 2, 225-229(Nov 1974).

Seven new OH sources have been discovered during a search out of the galactic plane for 1612-MHz emitters which might be OH/IR stars. Most of the sources have 1612-MHz characteristics of OH/IR stars but no obvious optical or infrared counterparts. It is suggested that such sources are distant long-period variables since the velocity separations of the 1612-MHz components of the sources are similar to those of OH-emitters identified as long-period variables. The present results indicate that future OH surveys should not be confined only to the galactic plane or to observations of bright infrared sources. (auth)

34264 EXPANDING ATMOSPHERE OF THE Of COMPONENT OF THE ECLIPSING X-RAY BINARY HD 153919. Hensberge, G. (Univ. of Amsterdam). Astron. Astrophys.; 36: No. 2, 295-298 (Nov 1974).

Mass loss rates from the Of star HD 153919 are estimated by comparing the observed P-Cygni profiles with those theoretically computed using the method described by Lucy (1971). The observed profiles are best reproduced by adopting a rate of mass loss of about 2×10^{-6} $M_{\odot}$/yr, and assuming an outward increasing expansion velocity (which is compatible with the observations). The relation between the mass loss rate obtained and the one needed to produce the observed x-ray intensity is discussed, and the agreement is found to be satisfactory. (auth)

34265 CARBON AND IRON ABUNDANCES FOR TWENTY F AND G TYPE STARS. Hearnshaw, J. B. (Paris Observatory, Meudon, France). Astron. Astrophys.; 36: No. 2, 191-199(Nov 1974).

Carbon and iron abundances are presented for twenty dwarfs and subgiants of spectral type about F6 to K0, as an extension of a program of differential fine analysis of the CH and Fe I spectra in disk stars. The results for the overall total of fifty stars are discussed, and the general trend of [C/H] $\approx$ $\frac{1}{2}$ [Fe/H], which was reported earlier, is confirmed. The possibility is briefly discussed that the evidence implies a change with time in the abundance distribution of the elements in the yield of newly-forming heavy elements which enrich the interstellar medium. The relation found between carbon and iron abundances implies a larger proportion of low-Z stars than would be deduced on the basis of [Fe/H] alone, and this largely resolves the well-known problem of the dearth of low-abundance stars relative to the predicted numbers. (auth)

34266 SPECTRAL PHOTOMETRY AND QUANTITATIVE ANALYSIS OF THE HELIUM STAR HD 168785. Kaufmann, J. P. (Technische Univ., Berlin); Schoenberner, D.; Rahe, J. Astron. Astrophys.; 36: No. 2, 201-210(Nov 1974).

A detailed spectral analysis of the helium rich star HD 168785 yields the following parameters: effective temperature, T_{eff} = 24,000 ± 1000°K; gravity, log g = 3.3 ± 0.15; hydrogen and helium abundances by number fraction, ϵ_H = 0.55 and ϵ_{He} = 0.45, respectively; microturbulent velocity, ν_t = 5.0 ± 2 km/s. Metals, especially oxygen, appear to be underabundant. From the proper motion data, the star should be not more than 1 kpc away. This, together with the atmospheric parameters yield the star's mass, m, radius, R, and luminosity L : $m/m_{\odot}$ = 1.0, $R/R_{\odot}$ = 3.4, $L/L_{\odot}$ = 4×10^3. Like HD 144941, HD 168785 seems to be another example of an evolved low mass star with moderate helium enrichment. (auth)

34267 FAINT M-TYPE STARS IN THE SOUTH GALACTIC POLE REGION. The, P. S.; Staller, R. F. A. (Univ. of Amsterdam). Astron. Astrophys.; 36: No. 2, 155-161(Nov 1974).

The distribution of M-type dwarfs located in the direction of the South Galactic Pole is studied, with the aim to find a possible explanation for the mass deficit in the galaxy, first noticed by Oort (1965). As lower limit of the calculations a density of 0.028 stars/pc^3 is found, in agreement with Jones' (1973) result (0.023 stars/pc^3) in the same direction. The Malmquist-Schalen (1928) method applied to our stars yields an average lower limit of 0.030 stars/pc^3. It is estimated that the real density should be about 0.06 stars/pc^3, which is 4 times less than that found by Murray and Sanduleak (1972) in the North Galactic Pole region. A discussion of the possible cause of this discrepancy is given. (auth)

34268 PERIOD BEHAVIOR OF 12 RR LYRAE VARIABLES IN M15. Wesselink, A. J. (Yale Univ., New Haven). Astron. Astrophys.; 36: No. 2, 163-172(Nov 1974).

Using old and new material from ten different sources extending from 1896 to 1970 the period behavior of twelve RR Lyrae variables in M15 has been investigated. The variables studied are: nos. 2, 14, 18, 19, 22, 23, 25, 26, 28, 35, 38 and 42 (see Catalog of Hogg, 1973). The periods of five variables are constant within the observational error. The periods of six variables have been increasing; only one variable has a decreasing period. The changes are within 1 part in 25,000 in 80 years. The observed rates of period change are in quantitative agreement with theoretical prediction. The surplus of increasing periods is also a natural consequence of the theory. (auth)

34269 PHOTOELECTRIC INVESTIGATIONS OF WEAK STELLAR MAGNETIC FIELDS. Severnyi, A. B.; Kuvshinov, N. S.; Nikulin, N. S. Izv. Krym. Astrofiz. Observ.; 50: 3-51(1974). (In Russian).

A photoelectric method of recording of stellar longitudinal magnetic fields was developed on the basis of direct Coude scanning spectrometer of the 2.6-meter reflecting telescope and ADP-plus-polaroid modulator of circular polarization included in the electronic scheme of synchronous phase-detector. The lines λ4254.35 Cr I and λ4233.17 Fe II were used as satisfying most of necessary requirements and covering the wide range of stellar spectral classes. (WDM)

34270 THREE COLOR PHOTOELECTRIC PHOTOMETRY OF α^2 CVn AND β CrB. Metik, L. P. Izv. Krym. Astrofiz. Observ.; 50: 63-67(1974). (In Russian).

The magnetic variables α^2 CVn and β CrB were observed photoelectrically with the 20 cm reflector of the Crimean Astrophysical Observatory in a photometric system close to UBV during July 3 to September 9, 1971. Two comparison stars were used for each variable. The accuracy (mean square error of one observation) was found to be equal ±0.014m. The results of observations are given. The curves of light and magnetic variations are given. The light curves of variables are similar in all three rays. Light and magnetic variations have the same period. Am-

plitudes of yellow, blue, and violet light curves equals accordingly to 0.05m, 0.03m, and 0.03m for α^2 CVn and 0.04m, 0.05m, and 0.05m for β CrB. (auth)

34271 OBSERVATIONS OF THE LINEAR POLARIZATION OF WHITE DWARFS RADIATION. Efimov, Yu. S.; Shakhovskoi, N. M. Izv. Krym. Astrofiz. Observ.; 50: 68-83(1974). (In Russian).

Results of multicolor (UBVR) observations of the linear polarization of 14 white dwarfs and hot subdwarfs are presented. The observations were made in 1969-1971. Appreciable linear polarization for some white dwarfs of various spectral types was found. The values of polarization were usually less than 1%. The only exception was GrW + 70°8247, which is known to have large linear and circular polarization. Polarization is apparently variable for the most of objects observed. The wavelength dependence of polarization is complex and variable. Variations of polarization in various colors were uncorrelated. For eight objects the systematic change of position angle of polarization plane with wavelength was detected. This effect may be explained by Faraday rotation of the polarization plane in magnetoactive plasma. The Faraday rotation measures obtained (1.5 to 25 rad/μm^2) correspond to magnetic fields of the order of 10^3 to 10^4 gauss for linear polarization arising in white dwarf photospheres. If magnetic fields are stronger than 10^5 gauss the linear polarization observed arises in the outer layers of white dwarf atmospheres (or in the magnetospheres). The values and signs of the rotation measures and of corresponding components of magnetic field may be time-dependent. (auth)

34272 STATISTICAL CORRELATIONS BETWEEN PARAMETERS OF THE DESCENDING BRANCHES OF UV CET-TYPE STAR FLARES. Shakhovskaya, N. I. Izv. Krym. Astrofiz. Observ.; 50: 84-92(1974). (In Russian).

Correlations were found between flare decay rates in different phases of the UV Cet type flares and flare luminosity at the maximum. It is shown that these correlations are common for flare stars of different luminosities. This means that flare decay rate is independent of stellar luminosity. However flares of larger luminosities have been observed more often on more luminous stars. The joint effect led to the observed Haro-Chavira and Kunkel correlations; the flares of shorter duration occur preferentially on stars of lesser luminosity. (auth)

34273 VERIFICATION OF APPLICABILITY AND MORE PRECISE DEFINITION OF THE CHARACTERISTICS OF FLARE ACTIVITY OF UV CET-TYPE STARS. Chugainov, P. F. Izv. Krym. Astrofiz. Observ.; 50: 93-102(1974). (In Russian).

Photoelectric light curves in the B filter were studied of five flare stars YZ CMi, UV Cet, EV Lae, AD Leo, and V1216 Sgr. It was found for each star that the mean duration of flares decreases with the decrease of their amplitude. (auth)

34274 SOME PHOTOMETRIC PECULIARITIES OF SYMBIOTIC STARS. Belyakina, T. S. Izv. Krym. Astrofiz. Observ.; 50: 103-105(1974). (In Russian).

The results of UBV photoelectric observations of 12 symbiotic stars have been considered. It must be noted that their light curves are very different (irregular, regular, Mira Ceti type) and on the two-color diagram (B-V)-(U-B) all these stars are located rather far to the right from the main sequence ones. Photometric peculiarities of symbiotic stars just mentioned can be explained assuming they are binary systems. (auth)

34275 SPECTROPHOTOMETRIC STUDY OF ECLIPSING-VARIABLE SYSTEMS CC CAS AND RZ CAS. Rachkovskaya, T. M. Izv. Krym. Astrofiz. Observ.; 50: 106-114(1974). (In Russian).

The spectra of eclipsing-variable systems CC Cas and RZ Cas were obtained with dispersions 15 Å/mm and 36 Å/mm within the spectral range λλ 3600 to 4900. The results of the study show, that in CC Cas and RZ Cas the spectra of the primary components are observed. Using equivalent widths of the lines obtained the physical parameters of atmospheres were determined. The RZ Cas atmosphere was analyzed by the curve of growth method. The following parameters were obtained: (1) the velocity v_0 = 4.87 km/sec; (2) the electron pressure lg P_e(Fe) = 2.08; (3) the excitation temperature T_e(Fe I, Ti II = 7600°); (4) the abundance of elements Fe and Ti. Abundance of Fe in the atmosphere of RZ Cas is some what less than in the Sun. The titanium abundance in RZ Cas and in the Sun is probably the same. The primary components of CC Cas and RZ Cas show the axial orbital synchronism. (auth)

34276 BALMER DECREMENT IN SPECTRA OF MOVING MEDIUMS. The Case of Collisional Ionization and Excitation. Gershberg, R. E.; Shnol, E. E. Izv. Krym. Astrofiz. Observ.; 50: 122-151(1974). (In Russian).

On the basis of the moving envelopes theory the Balmer decrement is calculated for the case when a steady state of an optically thick hydrogen plasma is maintained by nonradiative heating and ionization. (WDM)

34277 MODEL OF AN INTERNAL GRAVITATIONAL COLLAPSE. Nekrasov, A. G. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 47-50(1974). (In Russian).

The concepts of internal gravitational collapse were derived. Metrics concerned with the originally collapsing sphere and the collapse of spherical layers were found. (tr-auth)

34278 STATE OF SUPERDENSE MATTER. Kurdgelaidze, D. F.; Maksyukov, N. I. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 129-133(1974). (In Russian).

The equation of state of a superdense degenerate Fermi gas was studied in the framework of expanded 7-dimensional phase space. The equation of state obtained and the speed of sound were analyzed. The curved equilibrium configurations for superdense astronomical objects with consideration of the equation of state were given. The production thresholds for baryons and their resonances were given in the framework of the formalism developed. (tr-auth)

34279 EVOLUTION OF MAGNETIC BINARIES WITH MASS LOSS. II. Calculations with Magnetic Field. Drobyshevskii, E. M.; Reznikov, B. I. (Physical-Technical Inst., Leningrad). Acta Astron.; 24: No. 2, 189-205(1974).

A theoretical investigation was made of the role of magnetic fields in the evolution of close binaries. Because of the difficulties involved in any allowance for magnetic field effects, the nature of the presented analysis is mainly qualitative, and its results are only rough estimates. The three cases of evolution of systems containing a first-generation magnetic star that these results suggest are discussed. (IAA)

34280 UNDERSIZE SUBGIANTS. Hall, D. S. (Univ., Tuebingen, Ger.). Acta Astron.; 24: No. 2, 215-234(1974).

An examination of 25 binaries believed to include undersize subgiants is shown to indicate that there is no evidence to support the notion that there exists a subgroup of post-main-sequence mass-exchange remnants in which subgiants are smaller than their Roche lobes. The computed absolute dimensions used in showing this are mostly in good agreement with observed semi-amplitudes. (IAA)

34281 SOME APPLICATIONS OF MODEL ATMOSPHERES. Bessell, M. S. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 5, 230-235(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

Five aspects of model stellar atmospheres are discussed: (1) the results of white dwarf model atmosphere investigations; (2) the results of inclusion of non LTE phenomena in the atmosphere computations of hot (T ~ 15,000 k) stars; (3) the probable understanding of the cause of peculiar abundance patterns in the Ap and Bp and Am stars; (4) the advances in theory and observations of cool star atmosphere; and (5) the use of synthetic spectra and colors. (AUS)

34282 TEMPERATURE STRUCTURE OF A STELLAR ATMOSPHERE HEATED BY SOFT X RAYS. Wickramasinghe, D. T. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 5, 265-267(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

An approximate expression is obtained for the temperature structure of a stellar atmosphere heated by an external flux of soft x rays. Allowance is made for reradiation in both the soft x-ray and optical regions. The results indicate that the temperature structure is drastically changed from the grey T - τ relation, particularly at low optical depths. The stronger lines should appear in emission with the possibility of central absorption in certain circumstances. The x-ray heating of HZ Her is discussed briefly. (AUS)

34283 ASTROPHYSICAL APPLICATIONS OF ATOMIC PHYSICS. Seaton, M. J. (University Coll., London). pp 261-282 of Atoms, Molecules, and Lasers. Vienna; International Atomic Energy Agency (1974).

See STI/PUB-356.

In three sections the author discusses the information which can be deduced from the radiation emitted by: 1. Stellar atmospheres; 2. The solar corona; 3. Gaseous nebulae. (auth)

34284 CONVECTIVE INSTABILITY OF HYDROGEN-BURNING SHELLS IN β-CEPHEI STARS. Van der Borght, R. (Monash Univ., Clayton, Australia). Proc. Astron. Soc. Aust.; 2: No. 5, 269-270(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

The instability mechanisms associated with hydrogen shell-burning stars within the mass range 10 to 15 $M_{\odot}$ were investigated. It is shown that over-instability in a hydrogen-burning semi-convective layer has an e-folding time of approximately 4000 years. This may not be enough to cause enough mixing during the 40 to 50,000 years the star spends in its early shell-burning stage. Overinstability is also a poor mixer of the stellar material. (AUS)

34285 EVOLUTIONARY EFFECTS ON RADIAL PULSATIONS OF β-CEPHEI STARS. Jensen, J. O. (Monash Univ., Clayton, Australia). Proc. Astron. Soc. Aust.; 2: No. 5, 270-271(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

Previous experiments have indicated that β-Cephei stars are in the final stages of core hydrogen burning. As for the mode of variation, whether radial or nonradial pulsation, the main objections against the radial pulsation have been disproved. Therefore evolutionary sequences of stellar models have been constructed and analyzed for radial pulsations. It was observed that there was a coincidence in the β-Cephei phenomena and the onset of hydrogen burning in a shell, and it is suggested that the β-Cephei phenomena are radial pulsations driven by convection in a hydrogen burning shell. The stability analysis reveals that in the envelope the radial pulsations are damped and if driven from the interior will dissipate an energy of the same order of magnitude as the energy released by nuclear reactions. (AUS)

34286 DWARF NOVA EX HYDRAE. Watson, R. D.; Rayner, P. T. (Univ. of Tasmania, Hobart, Australia). Proc. Astron. Soc. Aust.; 2: No. 5, 271-274(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

High-time resolution photometric observations of EX Hya were obtained covering more than three cycles, including five eclipses. The observations were obtained with the Mt. Stromlo 76 cm telescope on the nights of 27 June and 2 July 1973, and 21 February 1974. White-light data were collected using a 1P21 photocell and logged on analogue tape. Detected photon rates were ~2000 sec^{-1} of which ~800 sec^{-1} came from the sky. The star was near minimum light when observed. The data were retrieved from the analogue record, with sample times of either 2 sec, 4 sec, or 8 sec. Observation conditions were particularly stable and sky and extinction effects could be removed in an approximate manner using reference star observations taken before and after the EX Hya run. Sample light curves were thus obtained. (AUS)

34287 UNIFORM SURVEY OF CLUSTERS IN THE SOUTHERN MILKY WAY. van den Bergh, S.; Hagen, G. L. (Univ. of Toronto, Richmond Hill, Ont.). Astron. J.; 80: No. 1, 11-16(Jan 1975).

The Curtis-Schmidt telescope of the Cerro Tololo Observatory was used to make a two-color survey of an ~12° side strip of the southern Milky Way extending from $l \approx 250°$ to $l \approx 360°$. A total of 262 clusters, 63 of which had not previously been catalogued, were found. The apparent distribution on the sky of the clusters in this uniform survey of the southern Milky Way is discussed. Three of the clusters in this list appear to have Cepheid variables within their apparent cluster diameter. The 10.7-day Cepheid TW Nor is located in cluster No. 182 = Lyngå 6. This is the longest-period Cepheid found so far in an open cluster, and preliminary observations by Madore seem to verify cluster membership. The 5.9-day Cepheid CS Vel may be a member of cluster No. 77 = Ruprecht 79 and the 7.0-day Cepheid SV Cru is a possible member of cluster No. 124 = Ruprecht 97. (auth)

34288 GLOBULAR CLUSTER COLORS AND THE COSECANT LAW. Burstein, D.; McDonald, L. H. (Univ. of California, Santa Cruz). Astron. J.; 80: No. 1, 17-30(Jan 1975).

All available integrated UBV colors and spectral types of globular clusters are analyzed to determine whether one can obtain the reddening from the integrated parameters. Reddening determinations by various authors for individual clusters from field stars, comparison of color-magnitude diagrams, etc., are collected and made consistent with one another. Using these data, the intrinsic color-spectral type relationships for globular clusters in the Galaxy are found to agree with those for M31, allowing for a reddening of M31 of $E(B-V) = 0.08 \pm 0.04$. The same color-spectral type relationships are found for early-type globular clusters by an analysis of the csc law of galactic absorption. From these determinations of the reddening, the presence of a hole in the dust layer in the vicinity of the Sun is confirmed. Evaluation of the reddening for late-type clusters shows that the reddening slope $X = E(U-B)/E(B-V)$ increases to approximately $X = 0.85$ for later spectral types. A comparison of the various methods of determining the reddening shows that the integrated B-V color and spectral type are adequate to determine E(B-V). The linear csc law is found to yield an average accuracy of about ±0.07 for E(B-V). Selection effects are found to be significant in the use of the csc law. A comparison of the reddenings for globular clusters with total absorption from galaxy counts yields $R = A_v/E(B-V) \approx 4$ to 8. However, the most reliable data are consistent with $R \approx 3$. (auth)

34289 ANGULAR DIAMETERS AND EFFECTIVE TEMPERATURES OF RED GIANT STARS FROM LUNAR OCCULTATIONS WITH SPECIAL REFERENCE TO μ GEMINORUM. Dunham, D. W.; Evans, D. S.; Vogt, S. S. (Univ. of Texas, Austin). Astron. J.; 80: No. 1, 45-47(Jan 1975).

Angular diameter measures of μ Geminorum made at occultation are reported leading to a mean value near 13 arc msec. This result is shown to be consistent with measures for stars of closely similar type. The calibration of effective temperature is in need of revision for normal M giants because of defects in the effective temperature-bolometric correction relationship hitherto adopted. (auth)

34290 OPTICAL COLORS AND POLARIZATION OF A MODEL REFLECTION NEBULA. I. Star Behind the Nebula. Shah, G. A. (Indian Inst. of Astrophysics, Bangalore). Pramana; 3: No. 5, 338-353(Nov 1974).

Simple models of a reflection nebula in the form of a plane-parallel slab containing smooth spherical solid particles in submicron size range were considered. Single scattering was assumed. The effect of varying the composition and size distribution function of the grains was brought out in the calculations using Mie theory of scattering. The analytical part of the geometry of the problem has been treated quite rigorously and the resulting expression for nebular intensity was presented in a somewhat new form. The case of the star behind the nebula was examined. A comparison of the theoretical results with the observations of the Merope nebula shows that the dirty ice grains with index of refraction about 1.3-0.1i and size parameter $a_0 = 0.5\ \mu$ give reasonable agreement with the colors. Simultaneously, the polarization in the visual and blue wavelength bands agree approximately up to offset angle of 6 minutes of arc. The larger offset angles pose an intriguing problem. The general trends of nebular colors and polarization with variation of real and imaginary parts of index of refraction and the size distribution parameter were tabulated to serve as a guide for further study of reflection nebulae with the star in the rear. (auth)

34291 URANIUM LINES IN THE SPECTRA OF PECULIAR A STARS: A SEARCH FOR RECENT R-PROCESS EVENTS. Cowley, C. R. (Dominion Astrophysical Observatory, Victoria, British Columbia); Adelman, S. J. Astrophys. Lett.; 16: No. 1, 5-7(1975).

Uranium wavelengths in the spectra of Ap stars are studied to see if they give any indication of a recent r-process event. It is concluded that there is no credible evidence for an admixture of uranium-235 in these stars, which would imply such an event. The evidence, though negative, is badly confused by blending of lines, and a final judgment must wait for an observational clarification of the situation. (auth)

34292 INTERPLANETARY SPACE: A NEW LABORATORY FOR RAREFIED GAS DYNAMICS. Spreiter, J. R. (Stanford Univ., CA); Ruzzi, A. W. pp 497-521 of Rarefied Gas Dynamics. Karamcheti, K. (ed.). New York; Academic Press, Inc. (1974).

From 8th international symposium on rarefied gas dynamics; Stanford, California, USA (Jul 1972). See CONF-720740-.

Interplanetary space provides simultaneously the best vacuum available to man and, because of the solar wind, a tenuous and unsteady high speed outflow of predominantly hydrogen gas from the sun, a remarkable variety of rarefied gasdynamics phenomena to observe. A review of these phenomena, and of the way in which the present level of understanding has been achieved, is given. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

34293 POSSIBILITY OF A GRAVITATIONAL EFFECT IN THE SPECTRA OF QUASI-STELLAR OBJECTS. II. Durgapal, M. C. (Jodhpur Univ., India). J. Phys., A (London); 7: No. 17, 2236-2247(21 Nov 1974).

In quasi-stellar objects the redshifts of the spectral lines are generally different in emission and absorption. It has been proposed that quasi-stellar objects which are at cosmological distances have a small contribution to their emission redshift due to their gravitational field (gravitational emission redshift = 0.01 to 0.04). The absorption takes place in clouds of gases moving under the influence of this gravitational field. Different possible types of motions have been considered for these clouds. Both $z_{ab} < z_{em}$ and $z_{ab} > z_{em}$ have been discussed. In order to ex-

plain the sharpness of absorption lines it has been assumed that the clouds of gases were ejected with a speed less than the escape velocity and at the time of absorption the velocity of a cloud is comparable to the velocity required for the Doppler width of the absorption lines. For illustration the quasi-stellar objects 3C191, Ton1530, and PHL1522 have been discussed. (auth)

34294 ACCELERATION BY OBLIQUE MAGNETIC ROTATORS: NEAR FIELDS AND RADIATION BRAKING. Ferrari, A.; Trussoni, E. (Turin Univ.). Astron. Astrophys.; 36: No. 2, 267-272(Nov 1974).

An analysis is presented of the effects of "near field" structure and radiation reaction on the motion of charged particles acted on by large amplitude electromagnetic waves of low frequency. We show that significant radiation braking occurs for the case of fast oblique magnetic rotators. The overall energetics of the process is discussed within the context of high-energy cosmic ray production by pulsars. (auth)

34295 NEW INTERFEROMETRIC POSITIONS OF WATER VAPOR SOURCES. Baudry, A.; Forster, J. R.; Welch, W. J. (Univ. of California, Berkeley). Astron. Astrophys.; 36: No. 2, 217-224(Nov 1974).

New absolute and relative position measurements of H_2O masers have been made in Orion A, W49N, ON1 and VYCMa. Some OH and H_2O sources are shown not to be coincident in Orion A. In W49N the high velocity H_2O features have been localized with respect to the main, low velocity features. All except one are within 2.5 arc sec of each other. The H_2O masers seen in the directions of ON1 and VYCMa are respectively identified with the compact H II region associated with ON1, and with the star. (auth)

34296 COMMENT ON GAMMA RAY LINES FROM ^{4}He. Kozlovskii, B.; Ramaty, R. (Goddard Space Flight Center, Greenbelt, MD). Astron. Astrophys.; 36: No. 2, 307-308(Nov 1974).

It is pointed out that excited states of ^{4}He cannot produce gamma ray line emission of astrophysical significance, contrary to a recent suggestion of Reina et al. (1974). (auth)

34297 IMPROVED COUNT OF RADIO SOURCES AT 1400 MHz. Fomalont, E. B. (National Radio Astronomy Observatory, Green Bank, WV); Bridle, A. H.; Davis, M. M. Astron. Astrophys.; 36: No. 2, 273-278(Nov 1974).

New observations at 1400 MHz with the NRAO 300-ft telescope have provided a comparison between the flux-density scales of the BDFL, Davis, Maslowski and Westerbork surveys. The flux-density adjustments determined from these new observations essentially remove the reported clustering of extragalactic sources based on the differences among these surveys at a source density of ~500 sr^{-1}. The counts at 408, 1400, 2700 and 5000 MHz exhibit significant differences which can be explained by a variation of the effective spectral index of sources with flux density. The required variation is consistent with observations of individual sources. The corrected count of sources at 1400 MHz between .01 and 100 Jy is compared with evolutionary and steady-state cosmological models. A steady-state model may be compatible with the count only if QSS redshifts greater than 0.5 are mostly not cosmological and the relative deficiency of intense sources with steep spectral index is due to local source clustering. (auth)

34298 APERTURE SYNTHESIS OF FORMALDEHYDE ABSORPTION IN Sgr B 2. Rogstad, D. H. (California Inst. of Tech., Pasadena); Lockhart, I. A.; Whiteoak, J. B. Astron. Astrophys.; 36: No. 2, 253-260(Nov 1974).

Synthesis observations of the 4830 MHz formaldehyde absorption originating near Sgr B 2 have been obtained with a resolution of 20 arcsec in right ascension and 40 arcsec in declination. The velocity resolution was 3.1 km s^{-1}. The results suggest that there are at least two absorbing clouds near the source. One cloud has a velocity of 80 km s^{-1} and is associated with only one of the two bright continuum components. Another cloud, with a velocity of 65 km s^{-1}, overlies the entire continuum distribution. At a velocity of 50 km s^{-1}, there is some evidence that a third cloud covers the southernmost region of the source. (auth)

34299 ABSORPTION LINES OF QUASISTELLAR OBJECTS: A KINEMATICAL DESCRIPTION. Alvarez, E.; Gracia-Bondia, J. M. (Universidad Autonoma de Madrid). Astron. Astrophys.; 36: No. 2, 299-303(Nov 1974).

It is shown that the experimental distribution of absorption redshifts of QSO,s is consistent with the assumption that these lines are due to the presence of interlopers physically unrelated to QSO,s. Some new formulas for the probability that the light emitted by a QSO be interrupted by an object located by chance in its line of sight have been obtained in the framework of the Kinetic Theory of Cosmology (KTC). This allows writing a "correlation function" between absorption and emission redshifts. The first moments of the contractions of this function are compared with observation. Making use of the hypothesis of KTC, it is possible to estimate the mass of interlopers and other typical features, as well as their contribution to the mean mass density in the universe. (auth)

34300 SEARCH FOR OPTICAL PULSARS AT THE SITES OF TWO RADIO PULSARS AND TWO SUPERNOVAE REMNANTS. Nevo, I.; Sadeh, D.; Frohlich, A. (Tel-Aviv Univ., Israel). Astron. Astrophys.; 36: No. 2, 311-313(Nov 1974).

Optical power spectra were obtained from the sites of the radio pulsars PSR 0950 and PSR 1929, and scanned them, without any a priori assumption as to the expected frequency, for coherent oscillations. A similar technique was used to search relatively large areas around the sites of the supernovae remnants Cas A and Tycho SN 1572. No significant optical pulsations were found. (auth)

34301 NUCLEAR ASTROPHYSICS. Reif, R. (Technische Univ., Dresden (German Democratic Republic). Sektion Physik). Wiss. Z. Tech. Univ. Dresden; 23: No. 1, 131-136(1974). (In German).

New results of nuclear astrophysics are discussed. After summarizing the theory of the element synthesis (thermonuclear reactions, s and r processes) actual presentations on the element synthesis in explosive situations are discussed. The nuclear aspects of the inner structure of neutron stars are reviewed. (INIS)

34302 LAWS OF PHYSICS AND NEW DISCOVERIES IN ASTROPHYSICS. Novikov, I. Veda Tech. SSSR; 2: No. 3, 49-52 (1974). (In Czech).

Translated from Zemlya i Vselennaya (1974), no. 2, p. 7.

The applicability of principal laws and theories of physics to outer space phenomena is discussed. The verifications of the predictions concerning the existence of neutron stars and of black holes are presented as illustrative examples. (INIS)

34303 DETECTION OF RADIATION FROM THE SYG X-3 SOURCE. Gal'per, A. M.; Kirillov-Ugryumov, V. G.; Kurochkin, A. V.; Luchkov, B. I.; Yurkin, Yu. T. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1801-1805(Sep 1974). (In Russian).

The results of the observation of the sky of the northern hemisphere, made Oct. 12, 1972, with a spark γ telescope on a balloon, are reported. An excess flux of quanta F ($\geq$40 MeV) = 2×10^{-4} quanta/cm^2sec was observed in that region of the sky in which the x-ray source Syg X-3 is located. (tr-auth)

34304 SPECTRUM OF SMC X-1. Peterson, B. A.; Vidal, N. V. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 5, 286-289(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

As part of a program to determine the mass of the x-ray source, SMC X-1, the spectra of its optical counterpart SK160 was obtained. A discussion is given of the spectrum of SK160, and it is compared with that of B0.5 Ia standard, HD152234, in the He-Si spectral classification system of Walborn. (AUS)

34305 AMPLIFICATION AND ABSORPTION OF THE 9 cm $^2\Pi_{\frac{1}{2}}$, J = $\frac{1}{2}$ A-DOUBLET LINES OF INTERSTELLAR CH. Gardner, F. F.; Robinson, B. J. (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Astron. Soc. Aust.; 2: No. 5, 253-255(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

Preliminary observations at the CH frequencies were made with the Parkes 64-m telescope in December 1973 and January 1975. CH lines were detected in many galactic HII regions and in the direction of the galactic center. Line profiles of CH were taken at 3264 and 3335 MHz. (AUS)

34306 COMMENT ON X-RAY SOURCE IDENTIFICATIONS. Thomas, R. M. (Univ. of Tasmania, Hobart, Australia); Davison, P.J.N. Proc. Astron. Soc. Aust.; 2: No. 5, 290-292(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

It is argued that there are considerable difficulties inherent in making x-ray/optical, x-ray/radio, and x-ray/x-ray identifications based solely on positional coincidences, and that hazards exist in trying to draw further conclusions, such as estimating source distances, from such identifications. X-ray/x-ray identifications are most prone to these difficulties because of position uncertainties, variability, and through confusion arising from the use of different nomenclatures by various groups. (AUS)

34307 FUTURE DEVELOPMENTS IN BALLOON-BORNE X-RAY ASTRONOMY. Thomas, R. M.; Greenhill, J. G. (Univ. of Tasmania, Hobart, Australia). Proc. Astron. Soc. Aust.; 2: No. 5, 292-293(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

Balloon-borne payload observations of cosmic x-ray sources continue to contribute significantly to the study of hard x-ray sources. Two types of x-ray observations most easily made from the balloon are: (a) the short-term temporal variation of the flux, on time scales up to a few hours, and (b) the photon energy spectrum above 20 keV. The known binaries can be classified observationally with regard to these two measurements. It is suggested that balloon-borne detectors will have an important role to play by supplementing the work of satellites and extending binary spectra to ~100 keV photon energy. (AUS)

34308 KRZEMINSKY'S OPTICAL CANDIDATE FOR CEN X-3. Wickramasinghe, D. T.; Vidal, N. V.; Bessell, M. S. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 5, 289-290(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

Krzeminsky has recently suggested an optical candidate for Cen X-3. This star was reported to be an ellipsoidal type light variable with an amplitude 0.07^m in V and a period apparently equal to that of Cen X-3. Spectra taken at Mount Stromlo Observatory indicate an O9 type star with no large scale changes in spectral type within the orbital period. A Roche lobe analysis using the light curve synthesis program was carried out in order to determine whether the available observational data on this star is consistent with the various constraints imposed by the x-ray data. From the observed light amplitude and the x-ray eclipse constraint it was found that (a) the primary must be in near contact with its inner critical Roche lobe, (b) the orbital inclination in 90°, and (c) the mass ratio $q\ (= M_2/M_1) \sim 0.045$ where M_1 and M_2 are the masses of the primary and secondary, respectively. (AUS)

34309 IMPLAUSIBLE HISTORY OF TRIPLE STAR MODELS FOR CYGNUS X-1: EVIDENCE FOR A BLACK HOLE. Shipman, H. L. (Univ. of Missouri, St. Louis). Astrophys. Lett.; 16: No. 1, 9-12(1975).

Models for Cygnus X−1 as a triple star system have been proposed as a way of avoiding the presence of a black hole. Consideration of the likely past history of these models indicates that the supernova explosion which preceded the formation of the neutron star would have caused the system to have become a runaway. Tidal evolution and mass exchange do not seem to offer much hope of avoiding the presence of a black hole. (auth)

34310 SEARCH FOR 4.8-HOUR MODULATION OF THE CYG X-3 INTENSITY IN HARD X-RAYS. Feretti, L.; Frontera, F.; Fuligni, F. (CNR, Bologna). Astrophys. Lett.; 16: No. 1, 13-15(1975).

Results of the analysis of a balloon observation of the Cygnus region were analyzed to search for the modulation of the intensity of Cyg X−3. An upper limit for the modulation ratio of 0.4 was found. It is concluded that this ratio is a decreasing function of energy. (auth)

34311 PHOTOGRAPHIC STUDY OF HDE 226868 (CYGNUS X-1) BASED ON ARCHIVE PLATES. Herczeg, T. J.; Sutton, J. K. (Univ. of Oklahoma, Norman). Astrophys. Lett.; 16: No. 1, 17-18(1975).

The optical object identified with Cygnus X−1 was measured on 60 short-exposure astrographic plates in the collection of the University of Oklahoma Observatory. The interval covered is April−November, 1949. There is indication of a small amplitude, periodic light variation, similar to the variability recently found by photoelectric observers. No evidence for secular changes of the brightness has been found. (auth)

34312 COPERNICUS: NEW POSITIONS FOR CYGNUS X-1 AND 3U 0352 + 30 (X PER). Hawkins, F. J.; Mason, K. O.; Sanford, P. W. (University Coll., London). Astrophys. Lett.; 16: No. 1, 19-22(1975).

Positions obtained with the Copernicus instrumentation confirm identification of Cyg X−1 with HDE 226868 and 3U 0352 + 30 with the X Per−ADS 2859B system. (auth)

34313 DISTRIBUTION OF THE H134α RECOMBINATION LINE IN W33. Gardner, F. F.; Wilson, T. L.; Thomasson, P. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astrophys. Lett.; 16: No. 1, 29-33(1975).

The H II region W33 has been mapped in the H134α line (2702.8 MHz) with an angular resolution of 4.8 arc min. The line emission has velocity peaks near 32 and 58 km/sec, and these occur over an appreciable part of the nebula. The observations are interpreted in terms of a source expanding at a velocity of about 15 km/sec. The clouds containing OH and H_2CO are believed to surround the nebula and to be pushed ahead of the expanding ionized shell. The electron temperatures derived with the assumption of an optically thin plasma at LTE show values of 4 to 5×10^3 K and 7 to 8×10^3 K in two extended regions, with higher values in a small region near the main continuum, high emission measure, peak. (auth)

34314 DIFFRACTION EFFECTS IN PULSATING RADIO SOURCES. Hopf, F. A.; Cocke, W. J.; Lubart, N. D. (Univ. of Arizona, Tucson). Astrophys. Lett.; 16: No. 1, 35-38(1975).

A pulsar radio emission model is developed to explore the effects of diffraction on pulsar beaming. At very low frequencies ($\nu \lesssim 2n$ MHz, where n is the number of pulse components), an increase of pulse width and the discovery of new pulsars are predicted. The pulse width increase might be difficult to untangle from interstellar scintillation effects. Observation of these diffraction effects would place restrictions on the size and radius of curvature of the emission regions. (auth)

34315 SEARCH FOR MILLIMETER-WAVE EMISSION FROM UHURU X-RAY SOURCES AND RADIO BINARY STARS. MacDonald, G. H. (Kent Univ., Canterbury, Eng.). Astrophys. Lett.; 16: No. 1, 39-42(1975).

A search was made for radio emission at wavelengths of 9.6 and 3.5 mm from 28 x-ray sources listed in the Uhuru catalogue and the three radio binary stars, β Persei (Algol), β Lyrae, and Antares B. No emission was detected from any object to a flux density limit of 10^{-26} W m^{-2} Hz^{-1} at either wavelength. (auth)

Solar Phenomena

Refer also to abstracts 32686, 34399, 34440, 34461, and 34662.

34316 (AD-787778) SOLAR GEOPHYSICAL DATA PROCESSING SYSTEM. Final Report, 1 July 1973−30 June 1974. Fusco, J. A.; Hickey, P. R. (Analysis and Computer Systems, Inc., Burlington, Mass. (USA); Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). Jul 1974. 21p. (AFCRL-TR-74-0376). NTIS $3.25.

The solar geophysical data processing system is part of a research and development effort performed at Air Force Cambridge Research Laboratories in conjunction with the air weather service. This R and D project is an effort to develop a system capable of processing data received on a daily basis from the Astrogeophysical Teletype Network (ATN). The solar geophysical data processing system consists of a series of programs designed for and implemented on the Air Force Global Weather Central (AFGWC) Univac 1108 computer system housed at Offutt Air Force Base, Omaha, Nebraska. The system processes the ATN data in real time, for a number of scientific disciplines including solar optics and solar radio. (auth)

34317 (AD/A-001123) MODEL OF CORONAL HOLES. Adams, W. M.; Sturrock, P. A. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Sep 1974. 20p. (SU-IPR-592). NTIS $3.25.

It has been noted that coronal holes appear to be associated with regions of diverging magnetic field in the corona. The hypothesis that coronal holes may be caused by an increased flow of energy into the solar wind resulting directly from a diverging magnetic field pattern was tested. Simple models were devised to approximate the energy flow down into the transition region and up into the solar wind as a function of the temperature, density, and rate of field line divergence in the corona. By assuming the rate of mechanical energy influx into the corona to be constant, it was then possible to solve numerically for the coronal temperature and density as a function of the rate of field line divergence. The results of these calculations demonstrate that a diverging field pattern can bring about reductions in the temperature and density at the base of the corona comparable to those observed in coronal holes. (auth)

34318 (COM-74-50190-360) SOLAR-GEOPHYSICAL DATA NUMBER 360, AUGUST 1974. Part I (Prompt Reports). Data for July 1974, June 1974. Leighton, H. I. (National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo. (USA)). Aug 1974. 135p. (SGD-360-PT-1; NOAA-74091028). National Climatic Center, Asheville, N. C. 28801 $1.25.

Prompt reports are given on data for July 1974 and June 1974. These deal with alert periods, daily solar indices, solar flares, solar radio waves and spacecraft observations. This issue also includes an index for 1973 and 1974. (GRA)

34319 (COM-74-50190-360) SOLAR-GEOPHYSICAL DATA NUMBER 360, AUGUST 1974. Part II (Comprehensive Reports). Data for February 1974, January 1974, and Miscellanea. Leighton, H. I. ((USA)). Aug 1974. 37p. (SGD-360-PT-2; NOAA-74091029). National Climatic Center, Asheville, N. C. 28801 $1.25.

Comprehensive data for February 1974 and January 1974 on solar flares, solar radio waves, abbreviated calendar record, and regional flare index are given. (GRA)

34320 (COM-74-50276-32) SYNOPTIC RADIO MAPS OF THE SUN AT 3.3 MM FOR THE YEARS 1967–1969. Mayfield, E. B.; White, K. P. III; Shimabukuro, F. I. (World Data Center A for Solar-Terrestrial Physics, Boulder, Colo. (USA)). Apr 1974. 32p. (UAG-32). National Climatic Center, Asheville, NC 28801 $0.35.

To summarize the results of three years' observation from 1967 through 1969, a synoptic presentation is used based on the Zurich heliographic maps of the Sun by Waldmeier (1968) and the magnetic field presentation of Mt. Wilson by Howard. These maps are arranged to present the 360 degrees of the solar disk showing the mm isotherms on a day near central meridian passage. A typical synoptic map is shown for Carrington rotation 1521. The vertical scale is the solar longitude between plus or minus 50 degrees. Maps used in the synoptic presentation have been normalized to the quiet regions. For presentation in this synoptic format, only isotherms from 4% enhancement up have been used. This is done to identify enhanced regions and to show the close correlation between the mm enhancement and white light faculae identified in the Zurich maps. (GRA)

34321 SUNSPOTS IN THE YEAR 1973. Mergantaler, J. Acta Geophys. Pol.; 22: No. 3, 291-294(1974). (In English and Polish).

The visual observations of solar photosphere were continued in the year 1973. A list of observers is given. The coefficient k reducing the observations to a homogenous scale is given. The total number of observational days was 324. (auth)

34322 RECENT ADVANCES IN DYNAMICAL ASTRONOMY. Proceedings of the Advanced Study Institute, Cortina d'Ampezzo, Italy, August 9–21, 1972. Tapley, B. D. (ed.). Astrophysics and Space Science Library, Volume 39. Dordrecht, Netherlands; D. Reidel Publishing Co. (1973). 475p. $46.30.

From proceedings of the Advanced Study Institute; Cortina d'Ampezzo, Italy (9 Aug 1972).

Topics discussed include the use of regularization in the solution of the differential equations arising in celestial mechanics, resonance phenomena displayed by the nonlinear differential equations governing dynamical astronomy, and aspects of the gravitational many-body problem. In particular, the problem of determining the proper regularizing transformation required for the stabilization of a numerical integration technique is discussed, as well as the application of nonlinear resonance theories to the near-resonance orbital conditions occurring in the solar system and to the couplings between the orbital and the rigid-body motion of satellites and planets, the use of general and special perturbation methods and classical and statistical orbit determination techniques, and the treatment of those problems which cannot be handled by perturbation techniques, such as the stellar three-body problem and the gravitational n-body problem. (IAA)

34323 SOLAR YTTRIUM ABUNDANCE. Allen, M. S.; Cowley, C. R. (Univ. of Michigan, Ann Arbor). Astron. Astrophys.; 36: No. 2, 315-316(Nov 1974).

The Y abundance in the Sun has been redetermined using newly measured equivalent widths. The previous value logY = 1.43 is revised to 2.0, in satisfactory agreement with the meteoritic abundance, 2.2. (auth)

34324 DEVELOPMENT AND FINE STRUCTURE OF THE FLARE ON JUNE 14, 1970. Babin, A. N. Izv. Krym. Astrofiz. Observ.; 50: 152-158(1974). (In Russian).

H_α-monochromatic observations of an important 3B flare with a high spatial resolution (~1''.5) are given. At the beginning the brightening of tiny plage elements (2 to 3'') took place, i.e. the event seemed to be spread out by the propagation of an excitation (which affected preheated elements) rather than by the motion of flare material. During the flash phase of the flare the ejection of a bright clump at an apparent velocity of about 700 km/sec was observed. After its maximum the flare had the appearance of a double ribbon. The two ribbons were not the result of the splitting of a single one, as every ribbon was formed independently. On the other hand, during the flash stage one of these ribbons showed a splitting itself with the distance between its components 5'' near the flare maximum. The flare ribbons revealed the fine structure. They consisted of small bright filaments and condensations with diameters of about 2 to 3'', but true sizes may be still smaller. Because the sizes of fine structure elements observed at the flare beginning and at maximum phase were about the same, the conclusion is made that the sizes of proper flare knots did not undergo any noticeable change during the flare growth, and their apparent increase can be attributed to the brightness rise and to the appearance of less bright diffuse material surrounding flare knots. (auth)

34325 MAGNETIC FIELDS AND BRIGHTNESSES AT DIFFERENT LEVELS IN THE QUIET REGIONS ON THE SUN. Tsap, T. T. Izv. Krym. Astrofiz. Observ.; 50: 159-167(1974). (In Russian).

Relations between the brightness, recorded in the core of different spectral lines, and between the brightness and longitudinal magnetic fields at different levels outside the active regions were studied. The records of brightness and magnetic fields were made with the double magnetograph of the Crimean astrophysical observatory. It was found that the features of the structure outside the active regions reflect mainly the magnetic field structure. The secondary maximum in the autocorrelation function of the brightness in the scale about 40 seconds of arc is visible only in 30% of the cases. (auth)

34326 STUDY OF THE MAGNETIC FIELD IN SUNSPOT UMBRAE USING THE DIFFERENT TEMPERATURE-SENSITIVE LINES. Guseinov, M. D. Izv. Krym. Astrofiz. Observ.; 50: 168-174(1974). (In Russian).

The magnetic field intensities H were measured in a few sunspots by using polarization spectrograms. The values of H determined by the spectral lines of Fe I λ6137.0, λ6173.3, λ6420.0, of Zr I λ6127.5, λ6143.2, and of Y I λ6435.0 Å were compared. The magnetic field in the dark small scale regions (knots) of umbra was found to exceed that in the umbral background by 300 gs. (auth)

34327 ESTIMATION OF THE RADIO EMISSION FLUX DENSITIES OF THE LOCAL RADIO SOURCES AT THE 1.9, 2.5, AND 3.5 CM WAVELENGTHS. Bachurin, A. F.; Eryushev, N. N.; Tsvetkov, L. I. Izv. Krym. Astrofiz. Observ.; 50: 175-179(1974). (In Russian).

The data for flux densities of four solar local radio sources at 1.9, 2.5, and 3.5 cm wavelengths are given. The observations were made with the 22-meter radio telescope at the Crimean Observatory. It was found that both the fluxes and the spectral indices change from source to source. When the source power decreases, the spectrum of that source becomes more gently sloping. (auth)

34328 BRIGHTNESS TEMPERATURE OF THE QUIET SUN IN THE WAVELENGTH RANGE 1.9 TO 3.5 CM. Bachurin, A. F.; Eryushev, N. N.; Tsvetkov, L. I. Izv. Krym. Astrofiz. Observ.; 50: 180-182(1974). (In Russian).

The data for brightness temperature of the "quiet" Sun in the wavelength range 1.9 to 3.5 cm are given. The observations were made with the 22 meter radiotelescope of the Crimean observatory. The brightness temperatures were found to be 9700 ± 500°, 10800 ± 500°, 12300 ± 600°, and 13000 ± 700°K at wavelengths 1.9, 2.5, 3.15, and 3.5 cm, respectively. In the considered range the brightness temperature increases approximately linearly with wavelength. (auth)

34329 NUCLEAR REACTIONS IN SOLAR FLARES DISCOVERED. Krivsky, L. (Astronomical Inst., Ondrejov, Czech.). Vesmir; 52: No. 9, 281(1973). (In Czech).

A brief list is presented of works confirming the occurrence of nuclear reactions in solar flares. (Nucl. Sci. Abstr. Czech)

34330 POSSIBILITY OF DETECTING HIGH ENERGY ELECTRONS IN THE SOLAR CORONA FROM SYNCHROTRON RADIATION. Vasil'ev, V. P.; Kucherov, V. I. (Kharkov State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1842-1845(Sep 1974). (In Russian).

The possibility of separating the synchrotron radiation of high-energy electrons in the background of the continuous spectrum of the solar corona is examined. It was proposed to use a method of measuring the spectral luminosity of the corona continuum for detection and determination of the characteristics of fast solar electrons directly in the region of generation and acceleration. (tr-auth)

34331 NUCLEAR REACTIONS IN THE SUN AND SOLAR NEUTRINOS. Vasil'ev, S. S.; Kocharov, G. E.; Levkovskii, A. A. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1827-1833(Sep 1974). (In Russian).

A method was developed for the construction of models which eliminated some deficiencies characteristic of contemporary methods for the construction of stellar models. This method is described. (JSR)

34332 ASYMMETRY OF SOLAR WIND. Gidalevich, E. Ya. (Ural Scientific Center, Sverdlovsk, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1863-1866(Sep 1974). (In Russian).

The dynamics of interstellar gas in the vicinity of the Sun were studied for the purpose of determining the limits of the solar wind. A comparison of the dynamic pressure of the solar wind and the pressure of the interstellar gas in the vicinity of the Sun showed that the region of slowing down of the solar wind in the apex direction occurs at a distance of 10 AU from the Sun. (tr-auth)

34333 EFFECT OF THE SECTOR STRUCTURE OF THE INTERPLANETARY MAGNETIC FIELD ON THE MODULATION OF COSMIC RADIATION. Bazilevskaya, G. A.; Okhlopkov, V. P.; Charakhch'yan, T. N. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1895-1898(Sep 1974). (In Russian).

An attempt was made to investigate the modulation of cosmic radiation by the sector structure of the interplanetary magnetic field over a long period of time (from 1958 to 1970) and to correlate this modulation with the 27-day variation of the cosmic radiation in this same period. (JSR)

34334 PROPAGATION AND GENERATION OF LOW ENERGY SOLAR PROTONS FROM THE DATA OF SPACE VESSELS. Gorchakov, E. V.; Timofeev, G. A.; Morozova, T. I. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1849-1854(Sep 1974). (In Russian).

An analysis was made of data on the anisotropy of low-energy protons ($E \gtrsim 1$ MeV and $E \gtrsim 5$ MeV) measured by Russian space craft. The values of the transport mean free path and the contribution of primary particles to the total current from the Sun were calculated. (tr-auth)

34335 GAMMA RADIATION OF SOLAR FLARES AND GENERATION OF COSMIC RADIATION. Gordon, I. M. (Inst. of Radiophysics and Electronics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1855-1858(Sep 1974). (In Russian).

It is shown that new experimental data confirms the conclusion that the γ radiation in the maximum of the flare of March 20, 1958, was caused by annihilation of positrons produced during p-p and p-α collisions of high-energy protons. It was also shown that the essential characteristics of intense proton flares are the sharp brief hardening of the cosmic particle spectra accompanying the intense flare of γ radiation of an annihilation origin. It is also suggested that at the moment of the maximum there should be observed an intense flare of hard γ radiation caused by the decay of π^0 mesons. The ionization losses of fast particles are the source of the optical radiation of the flare. (JSR)

34336 EPHEMERAL ACTIVE REGIONS IN 1970 AND 1973. Harvey, K. L.; Martin, S. F. (Lockheed Solar Observatory, Burbank, Calif., USA); Martin, S. F. (Kitt Peak National Observatory, Tucson, Ariz. (USA)). Solar Phys.; 40: No. 1, 87-102 (Jan 1975).

A study of ephemeral active regions (ER) identified on good quality full-disk magnetograms reveals: (1) On the average 373 and 179 ER were present on the Sun in 1970 and 1973 respectively. The number varies with the solar cycle. (2) The median lifetime of ER depends on observing quality and selection rules but is estimated as about 12 hr. for the data. (3) The latitude distribution is very broad but not uniform. The distribution peaks near the equator and shows variations similar to distributions of large active regions. (4) The longitude distribution is essentially homogeneous. (5) The spatial orientation of ER is almost random. In 1973 there is a hint of an excess of new cycle orientations at high latitudes. A comparison of parameters of ER and regular active regions suggests that ER are the small-scale end of a broad spectrum of active regions. The role of ER in the light of present theories of solar activity is investigated but is not yet clear. Heating of the chromosphere and corona may be significantly affected by ER. (auth)

34337 XUV OBSERVATIONS OF CORONAL MAGNETIC FIELDS. Sheeley, N. R. Jr.; Bohlin, J. D.; Brueckner, G. E.; Purcell, J. D.; Scherrer, V.; Tousey, R. (Naval Research Lab., Washington, D. C. (USA)). Solar Phys.; 40: No. 1, 103-121 (Jan 1975).

Spectroheliograms obtained with the Naval Research Laboratory's extreme ultraviolet spectrograph (S082A) on Skylab are compared with Kitt Peak National Observatory magnetograms. A principal result is the characteristic reconnection of flux from an emerging bipolar magnetic region to previously existing flux in its vicinity. Examples of the disappearance of magnetic flux from the solar atmosphere are also shown. The results of a particularly simple, potential field calculation are shown for comparison with the Skylab observations. (auth)

34338 THE MICROWAVE STRUCTURE OF CORONAL CONDENSATIONS AND ITS RELATION TO PROTON FLARES. Tanaka, H.; Enome, S. (Nagoya Univ. (Japan). Research Inst. of Atmospherics). Solar Phys.; 40: No. 1, 123-131(Jan 1975).

Active regions on the Sun in the 20th solar cycle are studied with special reference to their association with proton flares based on microwave interferometric observations at Toyokawa Observatory. It has been reconfirmed that the active regions associated with intense S-component emission with a high 3-cm to 8-cm flux ratio are likely to produce proton flares. About one fourth of 259 active regions during the period investigated are found to have definite features in the spatial distribution of polarization at a wavelength of 3 cm. Active regions with one particular type of polarization pattern have a good correlation with the occurrence of proton flares. (auth)

34339 PHENOMENOLOGY OF THE SUBFLARE; A SYNTHESIS OF CINOF. Jager, C. de (Astronomical Institute, Utrecht, Netherlands). Solar Phys.; 40: No. 1, 133-140(Jan 1975).

During the CINOF Campaign, June 1972, more than a hundred small chromospheric brightenings were observed. The observational results of about ten of them were investigated in more detail. They show a number of regularities which are listed. (auth)

34340 ANALYSIS OF THE AUGUST 7, 1972 WHITE LIGHT FLARE: LIGHT CURVES AND CORRELATION WITH HARD X-RAYS. Rust, D. M. (Sacramento Peak Observatory, Air Force Cambridge Research Laboratories, Sunspot, N. M., USA); Hegwer, F. (National Center for Atmospheric Research, Boulder, Colo. (USA)). Solar Phys.; 40: No. 1, 141-157(Jan 1975).

Cinematic, photometric observations of the 3B flare of August 7, 1972 are described in detail. The time resolution was 2 s; the spatial resolution was 1 to 2''. Flare continuum emissivity at 4950 Å and at 5900 Å correlated closely in time with the 60 to 100 keV nonthermal x-ray burst intensity. The observed peak emissivity was 1.5×10^{10} erg cm^{-2} s^{-1} and the total flare energy in the 3900 to 6900 Å range was $\sim 10^{30}$ erg. From the close temporal correspondence and from the small distance (3'') separating the layers where the visible emission and the x-rays arose, it is argued that the hard x-ray source must have had the same silhouette as the white light flare and that the emission patches had cross sections of 3 to 5''. There was also a correlation between the location of the most intense visible emissions near sunspots and the intensity and polarization of the 9.4 GHz radio emission. The flare appeared to show at least three distinct particle acceleration phases: one, occurring at a stationary source and associated with proton acceleration gave a very bluish continuum and reached peak intensity at ~1522 UT. At 1523 UT, a faint wave spread out at 40 km s^{-1} from flare center. The spectrum of the wave was nearly flat in the range 4950 to 5900 Å. Association of the wave with a slow drift of the microwave emission peak to lower frequencies and with a softening of the x-ray spectrum is interpreted to mean that the particle acceleration process weakened while the region of acceleration expanded. The observations are interpreted with the aid of the flare models of Brown to mean that the same beam of nonthermal electrons that was responsible for the hard x-ray bremsstrahlung also caused the heating of the lower chromosphere that produced the white light flare. (auth)

34341 LOCATION OF RADIO SOURCE AT 35 GHz OF 2145 UT 2 AUGUST 1972 BURST. Ogawa, H.; Kawabata, K. (Nagoya Univ. (Japan). Dept. of Physics). Solar Phys.; 40: No. 1, 159-163(Jan 1975).

The location of the radio source of a major burst at 2145 UT on 2 August 1972 was determined from observations undertaken by the 35 GHz solar interferometer at Nagoya. The location of the radio source coincides with an Hα brightening. (auth)

34342 X-RAY BURSTS FROM SOLAR FLARES BEHIND THE LIMB. Roy, J. R. (Hale Observatories, Pasadena, Calif. (USA)); Datlowe, D. W. (California Univ., La Jolla, San Diego (USA). Dept. of Physics). Solar Phys.; 40: No. 1, 165-182 (Jan 1975).

From the UCSD OSO-7 x-ray experiment data, 54 x-ray bursts with 5.1 to 6.6 keV flux greater than 10^3 photon cm^{-2} keV^{-1} which were not accompanied by visible Hα flare on the solar disk have been identified. By studying OSO-5 x-ray spectroheliograms, Hα activity at the limb, and the emergence and disappearance of sunspot groups at the limb, 17 active centers were found as likely seats of the x-ray bursts beyond the limb. The analysis of 37 x-ray bursts and their physical parameters are presented. The results are compared with those published by Datlowe et al., for disk events. The distributions of maximum temperature, maximum emission measure, and characteristic cooling time of the over-the-limb events do not significantly differ from those of disk events. It is shown that of conduction and radiation, the former is the dominant cooling mechanism for the hot flare plasma. Since the disk and over-the-limb bursts are similar, it is concluded that the scale height for x-ray emission in the 5 to 10 keV range is large and is consistent with that of Catalano and Van Allen (1973), 11000 km, for primarily 1 to 3 keV emission. Twenty-five or about .666 of the over-the-limb events had a nonthermal component. The distribution of peak 20 keV flux is not significantly different from that of disk events. However, the spectral index at the time of maximum flux is significantly different for events over the limb and for events near the center of the

disk; the spectral index for over-the-limb events is larger by about $\Delta\gamma = .75$. If hard x-ray emission came only from localized sources low in the chromosphere it would be expected that hard x-ray emission would be occulted over the limb; on the contrary, the observations show that the fraction of soft x-ray bursts which have a nonthermal component is the same on and off the disk. Thus hard x-ray emission over extended regions is indicated. (auth)

34343 HARD X-RAY BURSTS FROM FLARES BEHIND THE SOLAR LIMB. McKenzie, D. L. (Aerospace Corp., El Segundo, Calif. (USA)). Solar Phys.; 40: No. 1, 183-191(Jan 1975).

The determination of the location of the region of origin of hard x rays is important in evaluating the importance of 10 to 100 keV electrons in solar flares and in understanding flare particle acceleration. At present only limb-occulted events are available to give some information on the height of x-ray emission. In fifteen months of OSO-7 operation, nine major soft x-ray events had no reported correlated Hα flare. The hard x-ray spectra of eight of these events are examined with good candidate x-ray flare producing active regions making limb transit at the time of the soft x-ray bursts. All eight bursts had significant x-ray emission in the 30 to 44 keV range, but only one had flux at the 3σ level above 44 keV. The data are consistent with most x-ray emission occurring in the lower chromosphere, but some electron trapping at high altitudes is necessary to explain the small nonthermal fluxes observed. (auth)

34344 A MODEL EXCITER FOR TYPE III SOLAR RADIO-BURSTS. Harvey, C. C. (Observatoire de Paris, Section de Meudon, 92 (France)). Solar Phys.; 40: No. 1, 193-216(Jan 1975).

In an earlier paper (Harvey and Aubier, 1973) the large-scale radial electron density gradient in the corona and solar wind was shown to cause the phase velocity of plasma waves to decrease as they propagate away from the Sun, thus leading to appreciable Landau damping of the plasma waves. It is proposed here that this same phase velocity decrease creates conditions which facilitate the stabilization of a beam of exciter electrons of finite duration, provided that three conditions are fulfilled. Two of these conditions concern the velocity–time distribution of the exciter electrons at their point of ejection from the Sun, while the third is simply that, above a certain altitude, the coronal electron density decreases with altitude r faster than r^{-2}. The plasma wave source is then associated with the leading edge of the electron stream. The spatial density of the power converted into plasma waves is calculated as a function of position and time, and is shown to be independent of the nature of the stabilization mechanism. The maximum of this power density is found to move outwards from the Sun at a uniform speed when a simple electron injection model with a Maxwellian velocity distribution is introduced. (auth)

34345 ENERGY BUILD-UP AND RELEASE MECHANISMS IN SOLAR AND AURORAL FLARES. Obayashi, T. (Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science). Solar Phys.; 40: No. 1, 217-226(Jan 1975).

Flare phenomena in the solar atmosphere and in the terrestrial magnetosphere exhibit many similarities. The mechanical energy of enhanced photospheric motion is converted and stored in the form of magnetic potential energy in sunspot fields, which is analogous to the case of the growth phase of magnetospheric substorms. The energy release during the explosive phase is initiated by a sudden collapse in the magnetic field topology and the X-type magnetic neutral point is created in the corona. Subsequent electrical discharge takes place in the form of an intense electrojet current flowing in the base of the chromosphere at the altitude where the Cowling conductivity is a maximum. It is suggested that the field-aligned precipitation of hot electrons and the Ohmic heating in the chromosphere result in major features of solar flares. (auth)

34346 A NEW SHOCK LOCUS FOR SIMILARITY SOLUTIONS IN ONE-DIMENSIONAL UNSTEADY GAS DYNAMICS. Grundy, R. E. (Saint Andrews Univ. (UK)). Solar Phys.; 40: No. 1, 227-230(Jan 1975).

This paper deals with shock conditions for the progressing wave (or similarity) solutions of one-dimensional, unsteady gas dynamics. These solutions have hitherto been used to deal with the flow behind shocks moving into stationary atmospheres. By generalizing the shock conditions to the case of moving atmospheres, it is shown that the progressing wave solutions can be used to describe a certain class of flows, and a new shock locus can be constructed in the phase plane of the solutions. It is hoped that such solutions will be of use in describing the unsteady flow behind shocks propagating into the ambient solar wind. (auth)

34347 MAGNETIC AND THERMAL ENERGIES IN THE SOLAR WIND. Diodato, L.; Moreno, G.; Signorini, C. (Comitato Nazionale per L'Energia Nucleare, Frascati (Italy). Lab. per il Plasma nello Spazio). Solar Phys.; 40: No. 1, 231-234(Jan 1975).

Magnetic and thermal energy densities measured in the solar wind by the spacecraft Vela-3/IMP-3, Explorer-34, and HEOS-1 are compared. A linear relation seems to exist, on the average, between these parameters, suggesting a possible equipartition of energy between plasma and magnetic field. (auth)

34348 RECURRENT MAGNETIC ACTIVITY, SUNSPOT NUMBER AND ITS RATE OF DECLINE. Bhargava, B. N.; Rangarajan, G. K. (Indian Inst. of Geomagnetism, Colaba, Bombay, India). Solar Phys.; 40: No. 1, 235-239(Jan 1975).

Power spectral densities computed from low-latitude horizontal intensity of the Earth's magnetic field over two-year periods of declining phases of solar cycles 16 to 19 show a close relationship with the maximum relative sunspot number of the following solar cycles. The maximum sunspot number shows an exponential rise with the power density near $1/27$ cd^{-1}; maximum R_z, however, increases linearly with power density near $1/14$ cd^{-1}. It is also shown that the rate of decline of sunspot number in a solar cycle is almost exactly related, linearly, to power spectral density for the preceding solar cycle. Power densities near $1/27$ and $1/14$ cd^{-1} in declining phase of solar cycle appear to be satisfactory indices for the maximum relative sunspot number of the following cycle and its rate of decline thereafter. (auth)

34349 THE LOCKHEED DIODE ARRAY MAGNETOGRAPH. Smithson, R. C. (Lockheed Solar Observatory, Burbank, Calif., USA). Solar Phys.; 40: No. 1, 241-246(Jan 1975).

A new magnetograph using a solid state monolithic linear silicon diode array has been constructed at Lockheed Solar Observatory. This magnetograph uses a digital image processor, and makes data available both in digital and analog form. The diode array detector is capable of a signal-to-noise ratio of 2000: 1 or better when cooled to a temperature of −40° centigrade. Thus, intensity differences of the order of one part in a thousand may easily be detected without signal averaging. This instrument may be considered a prototype for an instrument using a two-dimensional array. The magnetograph is now fully operational, and is being used to produce data for statistical studies of solar magnetic field diffusion. (auth)

34350 ON CONVECTION IN THE SUN. Vandakurov, Yu. V. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). Solar Phys.; 40: No. 1, 3-21(Jan 1975).

Convective motions driven by a superadiabatic temperature gradient in a viscous thermally conductive medium are considered. Approximate linearized equations governing the perturbation are derived under the following conditions: (i) The ratio of the excess temperature gradient over the adiabatic gradient is small compared with the gradient itself. (ii) The perturbation is of low-frequency type. (iii) The rotation is slow. Only the convective mode is described by these equations (as in the Boussinesq approximation), and the equations are valid for compressible configurations with any ratio between the scale heights of the equilibrium and perturbed quantities. Results of a numerical calculation of unstable perturbations for configurations with a large density stratification are given. They show that under conditions appropriate for the solar convection zone an extremely strong instability is expected to occur if the mixing length is assumed to be equal to 1.5 times the pressure scale height. The horizontal scale of the instability is intermediate between those of granulation and supergranulation. The larger the mixing length, the smaller the growth rate of the instability, and the larger its horizontal scale. Therefore it seems possible to adjust the mixing length to obtain the characteristics corresponding to those of the solar supergranulation. The possible origin of the granulation as an instability in a subsurface zone, where a local increase in the density scale height takes place, is also discussed. To achieve agreement with observations, it seems necessary to assume that the ratio of the mixing length to pressure scale height is an increasing function of the pressure. (auth)

34351 CORONAL INFORMATION FROM EUV DISK SPECTRAL LINE INTENSITIES. Billings, D. E.; Alvarez, M. (Colorado Univ., Boulder (USA). Dept. of Astro-Geophysics). Solar Phys.; 40: No. 1, 23-28(Jan 1975).

Center of disk euv line intensities from quiet and active regions are used for determining an analytical expression for the variation of temperature with height in the lower corona, including the corona–chromosphere transition region. This approach imposes two coronal temperature regimes in both quiet and active regions. In each case the lower temperature regime is a continuation of the transition region, reaching a maximum of about 1.4 million deg in the quiet and 1.7 million deg in the active region. In the quiet region the high temperature regime, assumed isothermal,

has a temperature of about 2.4 million deg, and in the active region, about 4.2 million deg. (auth)

34352 THE ASYMMETRY OF THE Hα ABSORPTION COEFFICIENT. Zelenka, A. (Swiss Federal Observatory, Zurich, Switzerland). Solar Phys.; 40: No. 1, 39-52(Jan 1975).

Because of fine structure splitting and Lamb shift the seven lines of the Hα transition array do not fall together. The separation between the most intensive components amounts to 0.14 Å, a value which is comparable with the Doppler width representative of the layers where the solar Hα profile originates. Inclusion of this splitting in the line absorption coefficient leads to a better agreement between computed and observed profiles. The transfer problem needs not be solved for each of the seven lines, because the very intensive collisionally-induced term-term transition rates ensure the redistribution of the populations among the levels according to their degree of degeneracy. The Harvard Smithsonian Reference Atmosphere yields profiles which agree rather well with observations, the very line centre excepted. The new characteristic of these profiles is their asymmetry: the centre of symmetry of the line wings is not equal to that of the line core. (auth)

34353 HORIZONTAL VELOCITIES IN THE SOLAR PHOTOSPHERE. Dravins, D. (Lund Observatory, Sweden). Solar Phys.; 40: No. 1, 53-63(Jan 1975).

Horizontal macroscopic velocities V_{hor} in the photosphere are studied. High-resolution spectrograms of quiet regions are analyzed for center-limb variation of rms Doppler shifts. The data are treated to assure that the observed velocities refer to constant size volumes on the Sun (800 × 3000 × 250 km), independent of μ. Using known height variation of vertical velocities and calculated line formation heights, the height dependence of $\langle V_{hor} \rangle$ is obtained. From a value around 450 m s^{-1} it decreases rapidly with increasing height. To study also small-scale velocities, the time evolution of subarcsecond size elements in the photospheric network (solar filigree) is studied on filtergrams. It is concluded that they show proper motions implying $\langle V_{hor} \rangle$ about 1 km s^{-1}. (auth)

34354 A COMPARISON OF SPICULES IN THE Hα AND He II (304Å) LINES. Research Note. Moe, O. K. (Naval Research Lab., Washington, D. C. (USA)); Engvold, O.; Beckers, J. M. (Sacramento Peak Observatory, Air Force Cambridge Research Laboratory, Sunspot, N. M., USA). Solar Phys.; 40: No. 1, 65-68(Jan 1975).

On 1974 January 29 and 31, simultaneous ($\Delta t < 30$ s) observations were obtained in the 304 Å line on Skylab and in the Hα line with the vacuum telescope/universal filter combination at the Sacramento Peak Observatory. The Hα observations consist of filtergrams taken in rapid succession at the Hα line center Hα ± 0.5 Å. The observations were made near the north pole, since the 304 Å spicules appear to be best visible in the polar regions. Precise registration between the images was obtained by comparing the location of prominences at an adjacent part of the solar limb. This, however, was not as easy as first anticipated since prominences are quite different in appearance in the two lines. There definitely is not a one to one relationship between Hα and He II (304) brightness in prominences. Some of the brightest He^+ prominences are weak or absent in the Hα observations. Also inside each prominence the structures seem to be quite different. This limited the accuracy of alignment between the images to ±15″. (auth)

34355 EVOLUTION OF THE SOLAR LYMAN ALPHA FLUX DURING FOUR CONSECUTIVE YEARS. Vidal-Madjar, A. (Centre National de la Recherche Scientifique, 91 - Verrieres-le-Buisson (France). Lab. de Physique Stellaire et Planetaire). Solar Phys.; 40: No. 1, 69-86(Jan 1975).

Four consecutive years of a quasi-continuous survey of the solar Lα line are presented. Absolute calibration and aging correction are evaluated producing higher quality measurements which are: the total Lα flux, the central Lα flux, the blue wing flux at 0.33 Å from the center, the slope of the blue wing at the same location. Empirical laws are deduced from this large amount of data giving a relation between these different parameters and the flux integrated over the whole line. Furthermore, other empirical laws are obtained between the total Lα flux and two solar activity indices. These relations give a possibility of evaluating the solar Lα flux even when no observation is available and, as previously found by Prinz (1974), show that to a first approximation the solar Lα flux is composed of a quiet and of an active component. The active component changes with the 27 days period; the quiet one with the 11 yr solar cycle. (auth)

34356 PLASMA PHYSICS OF THE SOLAR ATMOSPHERE. Kaplan, S. A. (Nauchno-Issledovatel'skij Radiofizicheskij Inst., Gorkij (USSR)); Pikel'ner, S. B. (Sternberg Astronomical Institute, Moscow, USSR); Tsytovich, V. N. (AN SSSR, Moscow. Fizicheskij Inst.). Phys. Rep.; 15: No. 1, 1-82(Dec 1974).

A general picture of the phenomena in the upper layers of the sun is given, based on the interpretation of observations and on the theoretical considerations of the different plasma motions. Heating of the solar atmosphere by turbulent convection is considered, including models of the corona and the chromosphere. The magnetic structure of sunspots, chromosphere fibrils, solar spicules, "moustaches" and solar prominences is presented, and solar flares (including optical, ultraviolet, x-ray and radio emission of the flares) and solar radio bursts are discussed. (NL)

34357 EFFECT OF A MAGNETIC FIELD ON INDIVIDUAL CONVECTIVE CELLS. Murphy, J. O. (Monash Univ., Clayton, Australia). Proc. Astron. Soc. Aust.; 2: No. 5, 267-269(Sep 1974).

From 9th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

The quantitative effect of a magnetic field on the total heat flux in the solar convection zone and theoretical estimates of the cell size for maximum heat transfer through this zone have been presented in earlier papers. The results of a closer study of the structure of individual cells are given in this paper and a situation described where the magnetic field is concentrated by convective processes along the upper and lower cell boundaries. This suggests that actual measurements of the magnetic field associated with individual cells show a much stronger field present than the actual strength of the underlying unperturbed field. (AUS)

34358 POLARIZATION CHARACTERISTICS OF MOVING TYPE IV SOLAR RADIO BURSTS. Robinson, R. D. (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Astron. Soc. Aust.; 2: No. 5, 258-261(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

The results are presented of numerical integrations of the radiative transfer equations using the emissivity and absorption coefficients for synchrotron radiation as given by Ramaty (1969) in the limit of large Faraday rotation and corrected as proposed by Trulsen and Fejer (1970). The source model used is cylindrically symmetric with straight field lines and a magnetic field strength which decreases exponentially with distance from the centre of the source. A wide range of 1/e widths was considered; the results are here presented for a width of 3×10^5 km, roughly equivalent to an average observed source size. The emitting electrons are assumed to have an isotropic distribution of pitch angles and a differential energy distribution given by $N(E) = n_0 [(E/E_0)^2 \{1 + (E/E_0)^2\}]^{-1}$ with $E_0 = 100$ keV. The value of n_0 is chosen such that the source contains N_E particles cm^{-3} with energies greater than E_0, and a range of 10^{-2} to 10^{-1} cm^{-3} was used for this parameter. The results presented in this paper indicate that self-absorption of synchrotron radiation plays a decisive role in the observed emission from the Type IV source and must certainly be taken into account. It is also evident that the properties of synchrotron radiation from a source with inhomogeneous magnetic field structure differ significantly from those with an homogeneous field (self-absorption being considered in both cases). In particular, the inhomogeneity of the source (a) suppresses the polarization reversal predicted from source models with an homogeneous magnetic field, and (b) produces a "plateau" in brightness temperature when the source is optically thick in both magnetoionic modes. (AUS)

34359 SCATTERING HYPOTHESIS FOR TYPE V SOLAR RADIO BURSTS. Melrose, D. B. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 5, 261-263(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

The purpose of this paper is to advance an alternative hypothesis for the underlying distinction between solar radio bursts of spectral Type V and "inverted U" bursts, and to explore its implications. The existing suggestion for the distinction between Type V bursts and U-bursts is unsatisfactory and, as formulated, seems to be internally inconsistent. An alternative suggestion is that electron streams injected into a magnetic loop give rise to Type V bursts if the streaming electrons are effectively scattered while U-bursts result otherwise. This alternative appears to require that for scattering to be effective whistlers be generated by a pre-existing distribution of trapped electrons. (AUS)

34360 SUPERSONIC TURBULENT STRESS AND THE SOLAR NEUTRINO FLUX. Prentice, A. J. R. (Monash Univ., Clayton, Australia). Proc. Astron. Soc. Aust.; 2: No. 5, 263-265(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

Two conditions are required to explain a low solar neutrino flux at 4.7×10^9 yr (1) delaying the formation of a burnt-out core until

a late stage of evolution, and (2) diminishing the rate of burning of H in the radiative envelope surrounding the central core. In this paper it is shown how supersonic turbulence within a metal-rich burning central convective core provides the necessary physical mechanism for meeting the above requirements. It is concluded that it is supersonic stress, but no other nonthermal stress, which can lead to the formation of burnout solar models which have a present low neutrino flux. (AUS)

34361 POSITIONS OF ASSOCIATED TYPE II AND TYPE III SOLAR RADIO BURSTS. Duncan, R. A. (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Astron. Soc. Aust.; 2: No. 5, 255-258(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

A study was made of 44 solar events between January 1968 and July 1973 for which both Type III and second harmonic Type II emissions were observed at 80 MHz at Culgoora on both the spectrograph and heliograph. The simplest or most intense example of both Type III and second harmonic Type II trace were chosen and the times when these traces crossed 80 MHz were determined. The times were verified from radioheliograms and contours of source brightness were determined. The centroid of the contour with brightness $1/\sqrt{2}$ of the peak brightness was taken as the source position. The study supported the idea that magneto-hydromagnetic shocks concentrate, and Type II radio emissions arise within magnetically neutral sheets, and that associated Type III (electron stream) emissions also arise within or close to such sheets. It is also suggested that such sheets run north and south with r.m.s. dimensions of approximately $\frac{1}{2}$ $R_\odot$. (AUS)

34362 MECHANISM RESPONSIBLE FOR SHADOW TYPE III SOLAR RADIO BURSTS. I. Absorption Due to Langmuir Turbulence. Melrose, D. B. (CSIRO, Epping, New South Wales). Aust. J. Phys.; 27: No. 2, 259-269(Apr 1974).

The hypothesis is advanced that for "shadow" Type III solar radio events (absorption features with drift rates and bandwidths typical of Type III bursts or U-bursts) the absorption mechanism involves Langmuir turbulence, such absorption being the inverse of either fundamental ($f = f_p$) or second harmonic ($f = 2f_p$) plasma emission. The theory for both absorption processes is developed and applied to shadow Type III events with the following results: (1) the predicted absorption is confined to a very narrow frequency range ($\Delta f/f \sim 10^{-3}$); (2) effective absorption requires an energy density in Langmuir turbulence (with phase speeds $\sim\frac{1}{3}c$) in excess of 10^{-9} erg cm^{-3} for the fundamental and in excess of 3×10^{-6} erg cm^{-3} for the second harmonic; (3) the brightness of the background source must exceed 10^9 and 10^{16} K for absorption at the fundamental and second harmonic respectively. Comparison of the theory with the properties of an event discussed by Kai (1973) leads to the conclusions: (1) absorption at the second harmonic is unacceptable because of the high brightness temperature required; (2) to explain the observed bandwidth in terms of absorption at the fundamental, the absorbing region and the background source must overlap in height; (3) to explain the observed reduction in brightness temperature requires that the initial brightness temperature exceed 5.5×10^9 K (the observed value was 10^9 K). (auth)

34363 MECHANISM RESPONSIBLE FOR SHADOW TYPE III SOLAR RADIO BURSTS. II. Absorption Due to Ion Sound Turbulence. Melrose, D. B. (CSIRO, Epping, New South Wales). Aust. J. Phys.; 27: No. 2, 271-277(Apr 1974).

The hypothesis is explored that ion sound turbulence generated by the exciting agency for Type III bursts is responsible for shadow Type III events. The possible absorption mechanisms are listed: the most favorable are the coalescence of transverse waves and ion sound waves into Langmuir waves or the decay of transverse waves into Langmuir waves and ion sound waves. These mechanisms can operate only if the background source emits at the fundamental plasma frequency and the absorbing region is directly above it ($\lesssim 3 \times 10^4$ km). It is found that the event discussed by Kai (1973) can be explained in terms of such absorption with reasonable parameters, e.g., with an energy density in ion sound turbulence $W' \gtrsim 10^{-12}$ erg cm^{-3} at frequencies $\omega' \sim 0.3\ \omega_{pi}$ (where ω_{pi} is the ion plasma frequency). (auth)

34364 GYROMAGNETIC ABSORPTION AT THE FUNDAMENTAL. Melrose, D. B. (Australian National Univ., Canberra). Aust. J. Phys.; 27: No. 2, 279-283(Apr 1974).

Using a conventional procedure to treat gyromagnetic absorption in the center of the line at the fundamental, it is found that there is a small range of angles (~5° in the solar corona) where the damping is weak. The procedure used by Gershman (1960) is shown to be nonphysical in that the time-irreversible properties of the waves are calculated using the time-reversible response of the plasma and vice versa. (auth)

34365 SOLAR xuv FLUXES OF SOLRAD 10 SATELLITE FROM JULY 1971 TO DECEMBER 1971. Landini, M.; Fossi, B. C. M.; Poletto, G.; Tagliaferri, G. L.; Pallavicini, R. (Astrophysical Observatory, Arcetri, Italy). Soc. Astron. Ital., Mem.; 43: 383-388(1972).

34366 PROPAGATION OF ENERGETIC SOLAR PARTICLES IN WEDGE-SHAPED FLOWS. Roykhvarger, Z. B. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 169-174(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 201-206(1974).

Conditions at the surface of a steady hot-plasma flow are investigated. Expressions are obtained for the pressure and the half-angle of a wedge-shaped flow as a function of flow velocity and the half-angle of a shock wave. The range of steady-state flow is found. The average minimum energy of particles in the flow is estimated. (auth)

34367 FORECASTING THE RELATIVE CHANGES OF SHORT-WAVE SOLAR RADIATION INTENSITY IN THE 11-YEAR CYCLE. Ivanov-Kholodnii, G. S. (Inst. of Applied Geophysics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 157-160(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 188-191(1974).

Available data reveal three types of patterns: 1) the absolute intensities of the emission lines in the short-wave spectrum show only an average increase with increasing solar activity; 2) in contrast, the ratio of the intensities of two spectral lines varies more regularly with solar activity; and 3) the relative intensities of the lines are a definite function of the ionization potential of the emitting ion. The last two patterns are used to construct the coefficients of variation of the relative intensities of the emission lines upon transition from one solar activity level to another for different ionization potentials. These coefficients can be used to forecast the relative variations of the entire short-wave radiation spectrum in the course of a solar cycle. (auth)

34368 DETERMINATION OF THE TRANSPORT MEAN FREE PATH AND INTENSITY OF PRIMARY PROTONS FOR DIFFERENT PHASES OF SOLAR COSMIC-RAY BURSTS. Gorchakov, E. V.; Timofeev, G. A.; Morozova, T. I. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 161-163(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 192-195(1974).

Several solar cosmic-ray bursts recorded on Venera 4 are analyzed. The transport mean free path and the intensity of primary protons during each burst are computed on the basis of experimental data. (auth)

34369 EQUIPMENT FOR STUDYING THE ENERGY AND CHARGE SPECTRA OF SOLAR COSMIC RAYS ON PROGNOZ SATELLITES. Volodichev, N. N.; Vorob'ev, A. I.; Grigorov, N. L.; Kolesov, G. Ya.; Likin, O. B.; Malkiel, G. S.; Morozova, Ye. I.; Pisarenko, N. F.; Savenko, I. A.; Suslov, A. S. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 184-188(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 218-223(1974).

The physical characteristics of the equipment used to measure the energy and charge spectra of solar cosmic rays on Prognoz satellites are examined. The energy calibration of the detectors is described. (auth)

34370 SPLIT-BAND STRUCTURE IN TYPE II RADIO BURSTS FROM THE SUN. Smerd, S. F.; Sheridan, K. V.; Stewart, R. T. (Commonwealth Scientific and Industrial Research Organization, Sydney). Astrophys. Lett.; 16: No. 1, 23-28(1975).

The split-band structure of Type II bursts is here attributed to simultaneous plasma-frequency emission from plasma ahead of and behind a Type II shock front. The amount of band splitting is then a measure of the shock strength. Since the shock strength is the ratio of the disturbance speed to the Alfvén velocity and since the disturbance speeds can be derived from measured frequency-drift rates and an assumed coronal-density model, it is possible to derive the magnetic field strength along the path of the Type II disturbance. Shock strengths in the range $1.2 \lesssim M \lesssim 1.7$, and magnetic fields in the range $0.3 \lesssim H \lesssim 4$ G are thus obtained for nine split-band Type II bursts. (auth)

34371 KINETIC DESCRIPTION OF SOLAR WIND INTERACTION WITH SMALL CELESTIAL OBJECTS. Wu, S. T. (Univ. of Alabama, Huntsville); Dryer, M.; Fu, T. S. pp 523-533 of Rarefied Gas Dynamics. Karamcheti, K. (ed.). New York; Academic Press, Inc. (1974).

From 8th international symposium on rarefied gas dynamics; Stanford, California, USA (Jul 1972). See CONF-720740-.

The collisionless Boltzmann equation is used to analyze the solar wind interaction with "small" celestial objects. Results are presented for density and velocity contours in the vicinity of a typical celestial object. Some observations on and near the moon, possibly related to this study, are also shown. On the basis of similarities between these observations and the theory, it is suggested that the kinetic description be considered as an alter-

native to the guiding center and localized magnetic configurations currently under study. (auth)

34372 INTERPLANETARY MAGNETIC FIELD DIRECTION AND THE CONFIGURATION OF THE DAY SIDE MAGNETOSPHERE. Hill, T. W.; Rassbach, M. E. (Rice Univ., Houston). J. Geophys. Res.; 80: No. 1, 1-6(1 Jan 1975).

The direction of the interplanetary magnetic field appears to have a significant effect on the equilibrium size of the day side magnetosphere. The qualitative features of this effect are illustrated by means of a simple vacuum model that ignores solar wind and ionospheric plasma densities as a first approximation. This idealized model produces earthward displacements of the subsolar magnetopause and equatorward displacements of the polar cusp associated with southward-turning interplanetary fields that are about a factor of 2 greater than observed displacements. The nonzero solar-wind plasma pressure and ionospheric conductivity produce large deviations from the simple vacuum configurations but do not change the qualitative conclusions regarding magnetopause and cusp displacements associated with the north–south component of the interplanetary magnetic field. (auth)

34373 ALFVEN WAVES AND DIRECTIONAL DISCONTINUITIES IN THE INTERPLANETARY MEDIUM. Belcher, J. W.; Solodyna, C. V. (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Res.; 80: No. 1, 181-186(1 Jan 1975).

The properties of directional discontinuities occurring in selected periods of interplanetary magnetic field data are investigated. Microscale fluctuations in these selected periods have previously been identified as being predominantly Alfvénic on time scales ranging from 5 min to a few hours. It is argued that the majority of directional discontinuities in such periods are rotational and outwardly propagating. (auth)

Galaxies

Refer also to abstract 34301.

34374 INTERSTELLAR HYDROXYL AND WATER MASERS AND FORMALDEHYDE MASERS AND DASARS. ter Haar, D.; Pelling, M. A. (Oxford Univ.). Rep. Progr. Phys.; 37: 481-561 (1974).

A review is given of the observational data on anomalous emission by OH, H_2O, and H_2CO molecules and on anomalous absorption by H_2CO molecules. Various theories advanced to account for these data and some models of a few particular sources are discussed. (auth)

34375 RISING AND FALLING MOTIONS OF GAS ABOVE THE PERSEUS ARM. Sofue, Y.; Tosa, M. (Nagoya Univ., Japan). Astron. Astrophys.; 36: No. 2, 237-244(Nov 1974).

Rising and falling motions of neutral hydrogen (H I) gas above the Perseus arm are studied in detail on the basis of systematic variation of radial velocity of the H I gas with galactic latitudes. It is found that the gas is ejected out of the arm for duration of about 3×10^7 years with an initial speed of about 70 km/s in the z-direction. After reaching its maximum height of $z \approx 2$ kpc, the gas falls freely toward the galactic plane. The rising H I gases have a spatial correlation with H II regions and OB-clusters. An enhancement in the background radio emission is found above the Perseus arm ($l = 100° - 140°$) in coincidence with the region where the rising gas is observed. The rising motion is considered to be driven by an inflation of magnetic field due to enhanced cosmic ray pressure in and around this region. (auth)

34376 INTENSITY OF ROTATIONAL LINES OF H_2 AND HD FROM DENSE INTERSTELLAR CLOUDS. Drapatz, S.; Michel, K. W. (Max-Planck-Institut fuer Physik und Astrophysik, Garching). Astron. Astrophys.; 36: No. 2, 211-216(Nov 1974).

It is shown that the intensities of rotational lines of molecular hydrogen and hydrogen deuteride at 12.3, 17.0, 28.2, and 28.5μ can be appreciably lower than earlier predictions, if realistic excitation and deexcitation rates by collisions are taken into account. Furthermore, dust always concomitant with these molecular species in a dense cloud will absorb most of the line emission so that no reliable values on the absolute amount of the molecules will be obtained. A detailed study of atmospheric transmissions yields, however, that the lines at 17 and 28.2μ can be recorded from airplane altitudes, so that at least rotational temperatures in the cloud's boundary layer may be obtained with presently available techniques. (auth)

34377 LINEAR POLARIZATION PRODUCED BY IRON AND IRON OXIDE GRAINS. Codina-Landaberry, S.; Marcondes-Machado, J. A.; Magalhaes, A. M. (Sao Paulo Univ., Brazil). Astron. Astrophys.; 36: No. 2, 173-177(Nov 1974).

Iron and magnetic grains associated in chain-like structures have been obtained by striking an electric arc. These associations presented shape anisotropy with measurable polarization effects. The degree of linear polarization produced by such iron and iron oxide chains oriented by a magnetic field was measured in the wavelength band $1.4 < \lambda^{-1} < 2.8\mu^{-1}$. The wavelength dependence of the polarization thus obtained is compared with theoretical calculations. The results and some of their consequences are discussed. (auth)

34378 INTERACTION OF INTERSTELLAR GAS WITH STELLAR DENSITY WAVE PACKETS. Baker, P. L. (Goddard Space Flight Center, Greenbelt, MD); Barker, P. K. Astron. Astrophys.; 36: No. 2, 179-189(Nov 1974).

The interaction between interstellar gas and a gravitational perturbation produced by a fluctuation in the stellar mass distribution was studied numerically. For a simple equation of state, shock waves develop even if the gravitational perturbation is aperiodic and transient. In a medium which can change thermal phase, shocks do not form and the gas makes a transition directly to the cold, dense phase. The cold material has an anomalous velocity imparted to it by the gravitational perturbation and it becomes an accretion front moving through the hot gas and capturing it. The accretion fronts trigger thermal phase change on a large scale and can reproduce the extent of observed cold clouds. Furthermore their high mass is favorable to gravitational instability and subsequent star formation. (auth)

34379 INVESTIGATION OF THE CENTRAL REGION OF THE GALAXY NGC 3077. Artamonov, B. P.; Nasarova, L. S. Izv. Krym. Astrofiz. Observ.; 50: 115-121(1974). (In Russian).

The energy distribution of the continuous spectrum of the central part for different distances from the nucleus of NGC 3077 was obtained. The continuous spectrum of the nucleus of the galaxy is flat and more blue than that of the outer region. Duplicity of the nucleus in NGC 3077 was observed. The radiation flux in H_α and H_β lines for the nucleus of the galaxy was calculated. The continuous spectrum of NGC 3077 is similar to that of Seyfert galaxy NGC 1068. The possibility of the explanation of the gas ionization and ir-radiation of the nucleus NGC 3077 due to presence of planetary nebulae and their central stars is discussed. (auth)

34380 4830 MHz FORMALDEHYDE ABSORPTION IN A REGION OF THE SOUTHERN COALSACK. Brooks, J. W.; Sinclair, M. W.; Manefield, G. A. (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Astron. Soc. Aust.; 2: No. 5, 250-252(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

The detection of formaldehyde absorption in the region of the southern Coalsack is reported. The observations were carried out in March and November 1973 with the Parkes 64-m radiotelescope. Formaldehyde absorption was detected in the direction of four clouds of interstellar dust. The distribution of H_2CO absorption around the dust globules was measured. (AUS)

34381 THIOFORMALDEHYDE CLOUDS IN THE DIRECTION OF Sgr B2. Fourikis, N.; Sinclair, M. W. (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Astron. Soc. Aust.; 2: No. 5, 252-253(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

Preliminary mapping of the thioformaldehyde distribution in the direction of Sgr B2 followed the detection of the $2_{11} - 2_{12}$ transition of interstellar thioformaldehyde by Sinclair et al (1973). Observations were made with the Parkes 64-m telescope in conjunction with a 9 cm parametric amplifier. The half-power beamwidth of the telescope at the transition frequency, 3139-38 ± 0.03 MHz, was 6'.4 arc. The observations took place during two observing periods: 1971 December 13 to 17 and 1973 January 15 to 22. The line was detected at the position of the continuum maximum and at positions 3' and 6' arc north, 3' south, and 3' west, while a limit of 0.1°K antenna temperature was reached for the positions 3' east, 9' east and 9' north of the continuum maximum. (AUS)

34382 MOTIONS OF FORMALDEHYDE CLOUDS NEAR Sgr A. Whiteoak, J. B. (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Astron. Soc. Aust.; 2: No. 5, 248-250(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

It is well known that molecular cloud complex with a radial velocity of 40 km s^{-1} is located in front of and near Sgr A, the nonthermal source of the center of the Galaxy. The motion of this cloud is generally interpreted as contraction towards the center. In terms of the general kinematics of the Galaxy the existence of contraction is not firmly established—the main spiral features are either stationary with respect to the local standard of rest or expanding outwards from the center. However, as a result of a

high resolution study of the H_2CO absorption arising in a molecular cloud, an alternative interpretation not involving contraction is suggested. The kinematics of these molecular clouds can be interpreted in terms of an outward expansion from the nucleus. This is consistent with the motion of spiral features more distant from the center. (AUS)

34383 NEW SEARCH FOR HI IN THE SOUTHERN COALSACK. Kerr, F. J. (Univ. of Maryland, College Park); Bowers, P. F.; Harten, R. H. Aust. J. Phys.; 27: No. 2, 285-287(Apr 1974).

Since neutral hydrogen in dust clouds can often be detected from narrow self-absorption dips, two 21 cm profiles with a velocity resolution of 0.2 km s^{-1} have been obtained in the direction of the Southern Coalsack, in the hope of finding such a self-absorption dip. No neutral hydrogen could be detected. It is likely that most of the hydrogen in the Coalsack is molecular. (auth)

34384 PISTON SHOCK WAVES IN INTERPLANETARY SPACE. Krymskii, G. F.; Transkii, I. A.; Elshin, V. K. (Inst. of Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 164-168(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 196-200(1974).

The process of formation and the evolution of spherically symmetric piston shock waves appearing during the interaction of a fast and slow solar wind in interplanetary space are analyzed. It is significant that this type of wave has two shock fronts that are oriented in opposite directions and have a common contact surface on which the gas density and the magnitude of the frozen-in magnetic field acquire extreme values. It is demonstrated that the magnetic field in the vicinity of the contact has a large azimuthal component. (auth)

34385 FINDING LIST OF BRIGHT GALAXIES BEHIND THE SMC. Hodge, P. W. (Univ. of Washington, Seattle); Snow, T. P. Astron. J.; 80: No. 1, 9-10(Jan 1975).

A finding list and chart identify 30 probable galaxies with $V \lesssim 15$, seen behind the main body of the SMC. These objects could be useful for photoelectric study of the effects of the SMC interstellar dust. (auth)

Cosmology

Refer also to abstracts 34302, 34596, and 34668.

34386 (AD-786808) GRAVITATIONAL RADIATION. Final Report, 18 Sep-5 Oct 73. Pirich, A. R. (Rome Air Development Center, Griffiss AFB, N. Y. (USA)). Sep 1974. 40p. (RADC-TR-74-216). NTIS $3.75.

Since there are several similarities between general relativity and classical electromagnetism, this leads one to ask whether gravitational waves, like electromagnetic waves, really do exist. Difficulties due to the covariant nature of general relativity arise in the definition of a gravitational wave. A question which may arise is whether the waves carry energy or whether a radiating source loses mass. No exact solutions to the field equations are available to answer this question so approximation methods are used. From these solutions, one finds that some sources do emit gravitational waves, but whether freely gravitating systems (such as the solar system) lose energy or not is a matter to be resolved. (GRA)

34387 (N-74-29258) HIGH ENERGY ASTROPHYSICS. Ozernoy, L. M.; Prilutskii, O. F.; Rozental, I. L. Jul 1974. Translation of Astrofizika vysokikh energy, Atom Press, Moscow, 1973. (NASA-TT-F-15624). 301p. NTIS $18.25.

Problems least investigated in reviews and monographs, namely the interpenetration of methods in the physics of high-energy particles and astrophysics are discussed. Particular emphasis is placed on the theory of the processes of the interaction of high-energy particles existing in space, and the presentation of experimental data on processes occurring in stars, galaxies, and the metagalaxy recorded outside the optical range (infrared, x-ray, and gamma-ray astronomy). Heavy stress is placed on the interpretation of data observed in these energy ranges. (auth) (STAR)

34388 EVOLUTION OF PHOTOSTARS: THEORY. Larson, R. B. (Yale Univ. Observatory, New Haven). Fundam. Cosmic Phys.; 1: No. 1-2, 1-70(1974).

The theory of protostars—clouds of gravitationally bound interstellar material that are undergoing collapse into actual stars—is reviewed. Among the topics treated are the Jeans criterion and initial state of a protostar, temperature of protostellar material, boundary conditions for a collapsing protostar, collapse of a spherical protostar during the isothermal phase, collapse of an axisymmetric nonrotating cloud, collapse of an axisymmetric rotating cloud, effects of magnetic fields, collapse of a spherical protostar in the nonisothermal stage, accretion shock, temperature distribution in the infalling cloud, later evolution of a protostar of one solar mass, evolution of more massive protostars, the upper limit of stellar masses, infrared emission of protostars, properties of T Tauri stars and other pre-main sequence stars, and the dependence of the radius of a stellar configuration on its specific entropy. (IAA)

34389 VACUUM FLUCTUATIONS OF A SCALAR FIELD IN AN EINSTEIN UNIVERSE. Streeruwitz, E. (Vienna Univ. (Austria). Inst. fuer Theoretische Physik). Phys. Lett., B; 55: No. 1, 93-96(20 Jan 1975).

The influence of the vacuum fluctuations of a quantized scalar field on the effective gravitational Lagrangian is calculated for an Einstein universe (static and closed Robertson-Walker cosmology). (auth)

34390 THE COSMIC MICROWAVE BACKGROUND AND THE HADRON ERA OF THE EARLY UNIVERSE: A POSSIBLE CONNECTION. Dersarkissian, M. (Temple Univ., Philadelphia, Pa. (USA). Dept. of Physics). Phys. Lett., B; 55: No. 1, 84-86(20 Jan 1975).

A cosmological model is constructed which is a Friedman model, but with a finite ultimate temperature (T_F). A plausible argument is presented which suggests that the existence of T_F and the cosmic microwave background restricts the form of the hadronic level density: $\gamma(m) \xrightarrow{m\to\infty} Am^{-B} \exp(m/T_F)$, where A, B = constants. In the model, $B = 7/3 - 3/s$, where s = positive integer. The case $s = 3$ ($B = 5/2$) is the well-known Hagedorn model; the Frautschi model corresponds to $s = 6$ ($B = 3$); the cases $s = 1$ ($B = 1/2$) and $s = 2$ ($B = 2$) have not been considered before now. For each value of $B < 7/2$, the model gives the temperature (T_{γ_0}) of the microwave background as a function of A, T_F and ρ_0 (the present energy density of the universe). Two fascinating results then emerge: first, all estimates of T_{γ_0} favor a low density Friedman universe ($\rho_0 = 10^{-31}$ g/cm^3), which rules out a universe with positive curvature; second for $\rho_0 = 10^{-31}$ gr/cm^3 the best estimate of T_{γ_0} (~3K) occurs for the Hagedorn model. (auth)

34391 ON THE MASSIVE VECTOR FIELD OF A BLACK HOLE AND OF A NAKED SINGULARITY. Kuchowicz, B. (Warsaw Univ. (Poland)). Phys. Lett., A; 51: No. 1, 47-48(27 Jan 1975).

It is proved explicitly that the final state of a spherically symmetric gravitational collapse of matter endowed with a massive vector field may appear either as a black hole without any vector field outside the horizon, or as a naked singularity with a non-zero vector "hair". (auth)

34392 BASIS OF SPACE-TIME GEOMETRY. Aleksandrov, A. D. (Inst. of Mathematics, Novosibirsk, USSR). Dokl. Akad. Nauk SSSR; 219: No. 1, 11-14(1 Nov 1974). (In Russian).

Physically meaningful axiomatics of the space-time of the special theory of relativity are given. (JSR)

34393 SOME WAVE SOLUTIONS IN GENERAL RELATIVITY. Patel, L. K. (Gujarat Univ., Ahmedabad, India). Proc. Cambridge Phil. Soc.; 75: 261-267(Mar 1974).

A general scheme for the derivation of wave solutions in general relativity is developed. Some solutions describing the flow of gravitational waves are discussed. Singular electromagnetic fields corresponding to one particular solution are also discussed. (auth)

34394 RELATIVITY TIME-DELAY EXPERIMENTS UTILIZING MARINER SPACECRAFT. Esposito, P. G.; Anderson, J. D. (California Inst. of Tech., Pasadena). Telecommun. J.; 41: 299-306(May 1974).

Relativity predicts that the transit time of a signal propagated from the Earth to a spacecraft and retransmitted back to Earth ought to exhibit an additional, variable time delay. The present work describes some of the analytical techniques employed in experiments using Mariner spacecraft designed to test the accuracy of this prediction. Two types of data are analyzed in these relativity experiments; these include phase-coherent, two-way Doppler shift and round-trip, transit-time measurements. Results of Mariner 6 and 7 relativistic time-delay experiments are in agreement with Einstein's theory of general relativity with an uncertainty of 3%. (IAA)

34395 EQUATIONS OF THE PROBLEM OF N GRAVITATING ELECTRICALLY CHARGED BODIES, TAKING INTO ACCOUNT THE ARGUMENT DEVIATION IN THE GENERAL RELATIVITY THEORY. Pisarenko, V. G. (Inst. of Mathematics, Kiev). Dokl. Akad. Nauk SSSR; 217: No. 4, 800-803(1974). (In Russian).

Equations of the external problem of N gravitating moderately relativistic electrically charged noncolliding bodies were obtained on the basis of the equations of the general theory of relativity in which the space-time continuum is examined as a four-dimensional Riemannian space. (JSR)

34396 ROLE OF f-GRAVITY IN COSMOLOGICAL MODELS. Sivaram, C.; Sinha, K. P.; Lord, E. A. (Indian Inst. of Science, Bangalore). Curr. Sci. (India); 44: No. 5, 143(5 Mar 1975).

The role of a massive scalar–tensor theory of f-gravity in cosmology is clarified to remove earlier ambiguities. (auth)

34397 DETERMINATION OF THE ELECTRON TO PROTON INERTIAL MASS RATIO VIA MOLECULAR TRANSITIONS. Thompson, R. I. (Univ. of Arizona, Tucson). Astrophys. Lett.; 16: No. 1, 3-4(1975).

It is demonstrated that the wavelengths of molecular transitions are sensitive to the ratio of electron to proton inertial mass. Observation of molecular transitions can therefore provide checks on the invariance of this ratio in distant objects. If confirmed, the recent observation of H_2 absorption lines in QSO spectra would allow a determination of m_e/m_p for these objects. (auth)

Planetary Phenomena

34398 ASTRONAUTICAL RESEARCH 1970, 21ST CONGRESS OF THE INTERNATIONAL ASTRONAUTICAL FEDERATION, KONSTANZ, GER., OCTOBER 4–10, 1970. Napolitano, L. G.; Contensou, P.; Hilton, W. F. (eds.). Amsterdam; North-Holland Publishing Co. (1971). 1097p. (In English and French). $50.00.

From 21st congress of the International Astronautical Federation; Konstanz, Ger. (4 Oct 1970).

Research reports on theoretical problems in astronautics, engineering and management aspects of space technology, and the utilization and applications of spacecraft. Topics considered include spacecraft dynamics, reentry physics, planetary physics and chemistry, bioastronautics, space-shuttle and space-station design, propulsion systems and materials, navigation and guidance problems, sensor technology, on-board data management, flight program management, earth resources satellites, scientific experiment spacecraft, meteorological satellites, and uses of satellites in the field of education. (IAA)

34399 SOLAR COSMIC RADIATION, DECAMETER RADIO EMISSION OF JUPITER, AND MERIDIAN STRUCTURE OF THE SOLAR WIND. Levitskii, L. S.; Vladimirskii, B. M. (Crimean Astrophysical Observatory, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1846-1848(Sep 1974). (In Russian).

The possible effect of solar cosmic radiation on the intensity of the decameter radio emission of Jupiter was studied. It is shown that for days after a proton flare the decameter activity of the planet increases. The effect was detected only outside of the calm zone. (tr-auth)

34400 JUPITER RADIO BURSTS. Ellis, G. R. A. (Univ. of Tasmania, Hobart, Australia). Proc. Astron. Soc. Aust.; No. 5, 236-243(Sep 1974).

From 8th annual conference of the Astronomical Society of Australia; Hobart, Australia (22 May 1974).

All the basic properties of the Jupiter radio bursts may be explained if the mechanism is cyclotron radiation from electrons in the Io L shell and with a magnetic field model almost the same as that found by Pioneer 10. For wave frequencies above about 25 MHz the main features of the Io-correlation arise from the variation of the maximum observable cyclotron frequency around the locus of the foot of the Io flux tube near the surface of Jupiter. For lower frequencies the original theory of Ellis (1962, 1965) provides a satisfactory description when up-dated to take into account the Pioneer 10 observations. At the same time it is clear that there is an extremely rich field of complex radio phenomena in the Jupiter magnetosphere and much work will be needed to explore their properties in detail. (AUS)

34401 MARTIAN GRAVITATIONAL FIELD. Zagrebin, D. V. (Inst. of Theoretical Astronomy, Leningrad). Dokl. Akad. Nauk SSSR; 219: No. 1, 57-58(1 Nov 1974). (In Russian).

Formulas are derived that approximate the topographic surface of Mars and can represent the normal distribution of gravitational forces on its surface. (JSR)

34402 ^{244}Pu FISSION TRACKS: AN ALTERNATIVE EXPLANATION FOR EXCESS TRACKS IN LUNAR WHITLOCKITES. Pellas, P.; Storzer, D. (National Center for Scientific Research, Paris). Science; 187: No. 4179, 862-863(7 Mar 1975).

Recently Hutcheon and Price (1972) reported on the presence of ^{244}Pu fission tracks in a large shocked whitlockite crystal in lunar breccia 14321. An alternative explanation for the excess tracks is presented. (WDM)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 32771 and 34371.

34403 (AGARD-CP-138) NONLINEAR EFFECTS IN ELECTROMAGNETIC WAVE PROPAGATION. (Advisory Group for Aerospace Research and Development, 92—Neuilly-sur-Seine (France)). May 1974. 438p. (CONF-731135-).

From AGARD-NATO meeting; Edinburgh, Scotland, UK (Nov 1973).

The purpose of this meeting was to bring together workers from the fields of ionospheric physics, laboratory plasma physics and controlled thermonuclear reaction (CTR) research to discuss nonlinear effects in electromagnetic wave propagation. Such nonlinear effects came into great prominence recently in connection with experiments in which very large rf powers are radiated from the ground towards the ionosphere at a frequency below the F2 penetration frequency. Nonlinear effects also play an important part in certain aspects of whistler wave propagation and of resonances excited by topside sounders. An altogether different type of modification of one radio wave by another was observed very much earlier in the E-region and below it. More recently wave interaction phenomena were used for investigations of the lower ionosphere and for the diagnostics of weakly ionized laboratory plasmas. All these aspects were discussed. (auth)

34404 (N-74-30161) PLASMA INSTABILITIES AND MODEL RADIO AURORA. Volosevich, A. V.; Liperovskii, V. A.; Sverdlov, Yu. L. (AN SSSR, Moscow). Jul 1974. Translation of Preprint No. 153. (NASA-TT-F-15675). 49p. NTIS $5.50.

Theoretical work dealing with the possible types of plasma instabilities associated with currents, fluxes of incoming particles, and electron density gradients is discussed with reference to the polar ionosphere. The theory developed up to the present time explains in general terms the properties of the observed radio reflections. (auth)

34405 ELECTRON PLASMA RESONANCES IN THE TOPSIDE IONOSPHERE. McAfee, J. R. (NOAA, Boulder, CO). Fundam. Cosmic Phys.; 1: No. 1-2, 71-117(1974).

Some resonant responses to RF pulses in the topside ionosphere are discussed. These responses, as distinct from normal electromagnetic echoes, show prolonged ringing after the exciting pulse. The stronger resonances, occurring at the plasma, upper hybrid, and cyclotron harmonic frequencies, can be explained in terms of electrostatic wave propagation and reflection. The electrostatic wave theory for the upper hybrid and plasma frequency resonances is presented in detail, and a similar treatment is suggested for the cyclotron harmonics and the maximum frequencies of the Bernstein modes. Several of the less-pronounced resonances can in principle be explained by including nonlinear effects, but many of them remain obscure. (IAA)

34406 TROPICAL AIRGLOW. Kulkarni, P. V. (Physical Research Lab., Ahmedabad (India)). Ann. Geophys.; 30: No. 1, 105-115(Jan 1974).

Recent research on the tropical airglow is summarized in the following areas: (a) Newly detected emissions, (b) the reactions responsible for these emissions and the rates of reactions, (c) dynamical processes observed in night airglow by satellite borne and ground based experiments and their interpretations (d) dependence of some radiations on magnetic activity, solar flares etc. It must be noted that many airglow emissions in the tropics (±25 deg latitude) show entirely different behavior in intensity variations compared to those on the magnetic equator. (INIS)

34407 VARIATIONS OF SPREAD-F OCCURRENCE RATES AT NEAR-EQUATORIAL STATIONS IN THE AUSTRALASIAN ZONE. Cole, D. G.; McNamara, L. F. (Ionospheric Prediction Service, Darlinghurst, New South Wales). Aust. J. Phys.; 27: No. 2, 249-257(Apr 1974).

The occurrence rates of spread F for selected years between 1964 and 1972 are presented for three Australian stations lying between 10° and 25° magnetic latitude. Spreading is mainly of the range-spreading type. Two types of spread F are observed: one occurs during the solstices and correlates negatively with sunspot number; the other occurs during the equinoxes and correlates positively with sunspot number and negatively with magnetic activity. The relative importance of the two types is found to vary with latitude. (auth)

34408 MAGNITUDES OF CHARGED-PARTICLE FLUXES AT HEIGHTS OF 200 TO 300 KM. Basilova, R. N.; Grigorov, N. L.; Kalinkin, L. F.; Kogan-Laskina, E. I.; Pugacheva, G. I.; Savenko, I. A. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 301-303(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 360-361(1974).

Information on the magnitude, composition, and angular distribution of fluxes of charged particles with energies $E \geq 10^7$ eV at heights of several hundred kilometers has been recently in several papers. Therefore, it was thought to be of interest to supplement these data with the results obtained by an instrument installed on Kosmos 490. The measurements were made from May 17 to 25, 1972. (WDM)

34409 LAG OF THE COMMENCEMENT OF A NEGATIVE DISTURBANCE IN THE F REGION OF THE IONOSPHERE FOLLOWING A GEOMAGNETIC STORM OF THE SC TYPE. Khocholava, G. M.; Mebagishvili, N. N. (Inst. of Geophysics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 305-307(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 364(1974).

Ionospheric disturbances in the F-region of the midlatitude ionosphere are fairly complex so that it is very difficult to classify them. These disturbances are divided into 4 types: positive, negative, positive—negative, and mixed. The time of the commencement of negative disturbances in the F-region following geomagnetic storms of the SC type is studied. (WDM)

34410 EFFECT OF THERMAL DIFFUSION ON THE DISTRIBUTION OF ADMIXED IONS IN THE IONOSPHERIC F_2 REGION. Deminov, M. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 307-308(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 365-366(1974).

The effect of thermal diffusion on the diffusion-equilibrium distribution of major (O^+) and admixed (H^+, He^+, N^+) ions at the heights of the F_2 region of the ionosphere is examined. The effect of currents on ion distribution has been examined previously. For a plane-stratified (all parameters depend only on height z) model of the medium at middle and high latitudes, the condition of diffusion equilibrium is represented. (WDM)

34411 METHOD FOR DETERMINING THE VERTICAL PARAMETERS OF TRAVELING IONOSPHERIC DISTURBANCES. Drobzhev, V. I.; Kudelin, G. M.; Nurgozhin, B. I.; Pelenitsin, G. M.; Troitskii. (Ionospheric Sector, Kazakh, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 308-311(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 367-368(1974).

It has been demonstrated previously that all the experimental records of signal amplitude fadings relating to the split and nonsplit segments of an ionogram (polarization, random, regular fadings, etc., as well as their temporal variations) can be explained if one proceeds from the model of a large-scale wave screen and assumes the fading to be the result of the interference of a small number of rays formed by the screen. The problem of determining the vertical parameters of disturbances by spaced-frequency (frequency diversity) reception has also been stated. However, the shortcomings of the model of radio wave propagation, which was constructed without allowance for the dispersion of the medium and with an insufficiently correct estimate of the role of the geomagnetic field, did not permit making reliable methodological recommendations for the processing of experimental data. Here a method is described for determining the magnitude and direction of the vertical velocity component, wavelength, and period of a disturbance from a synthesis of polarization fading for various frequencies, obtained with allowance for the dispersion of the ionosphere and for the effect of the magnetic field. (WDM)

34412 AURORAL PULSATIONS IN THE 1- TO 10-Hz RANGE. Lipov, O. S.; Roldugin, V. K. (Polar Geophysical Inst., Kila, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 313-315(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 371-372(1974).

Recent photometric observations have shown that the intensity of auroras contains, in addition to the most characteristic 5- to 10-sec pulsations, also higher-frequency pulsations. Special photometric observations were performed at Loparskaya on March 24-31, 1972, to study the high-frequency (exceeding 1 Hz) auroral pulsations in detail. (WDM)

34413 IONOSPHERIC MODEL WITH ALLOWANCE FOR PLASMA MOTION ALONG GEOMAGNETIC LINES OF FORCE. Krinberg, I. A.; Kuz'man, V. A.; Gershengorn, G. I. (Siberian Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Irkutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 189-194(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 224-230(1974).

The possibility of constructing a model of the ionosphere along a geomagnetic line of force for heights h > 200 km in a single-ion approximation with allowance for the vertical variation of ion mass is investigated. It is demonstrated that the nighttime ionosphere at h > 200 km is sustained by fluxes of the thermal plasma accumulated in a geomagnetic force tube during daylight. (auth)

34414 EFFECT OF ATMOSPHERIC TEMPERATURE AND DENSITY ON THE VARIATIONS IN THE THICKNESS OF THE DAYTIME F REGION IN WINTER. Potapova, N. I.; Shapiro, B. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 195-200(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 231-238(1974).

The characteristics of the vertical and cyclic variations in the thickness of the daytime F_2 layer in winter are investigated. Disturbance of the thermal equilibrium and of the horizontal wind of the neutral atmosphere is found to affect the magnitude and variations of the thickness parameter q_c in winter. (auth)

34415 FORMATION OF A NARROW SPORADIC E LAYER. Nesterov, V. P. (Inst. of Experimental Meteorology, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 201-204(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 239-243(1974).

A narrow gradient E_s layer has been recorded. The ratio of electron density at the layer maximum to the background density is ~10^3. To explain this layer, it is assumed that it forms at middle latitudes as a result of the bombardment of the atmosphere by fluxes of high-energy trapped by the geomagnetic field. (auth)

34416 STRUCTURE OF THE LARGE-SCALE ELECTRIC FIELD IN THE HIGH-LATITUDE IONOSPHERE. I. Gurevich, A. V.; Krylov, A. L. (Lebedev Inst. of Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 205-209 (1974).

Translated from Geomagn. Aeron.; 14: No. 2, 244-249(1974).

Boundary conditions are formulated for the equations of the electric field at the outer boundary of the magnetosphere. The solution of these equations is found in the approximation of homogeneous integral conductivity. (auth)

34417 POSSIBLE EFFECT OF THE WIND SHEAR MECHANISM ON THE IONIZATION BALANCE IN THE LOWER IONOSPHERE DURING MESOSPHERIC WARMINGS IN WINTER. Erofeev, N. M.; Kalinovskaya, G. P. (Siberian Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Irkutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 210-214(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 250-255(1974).

The variations of stratospheric temperatures, ionospheric absorption, of the H component of the geomagnetic field, and of the drift components in the E layer during winter warmings are investigated. The identified patterns indicate that wind in the ionosphere affects the ionization balance at the levels of enhanced absorption. (auth)

34418 ROLE OF SCATTERING DURING RADIO-WAVE REFLECTION FROM THE IONOSPHERE. Vlasova, O. K.; Gaylit, T. A.; Gusev, V. D.; Prikhod'ko, L. I. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 215-218(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 256-260(1974).

The fluctuations of the angles of arrival of radio waves reflected from the ionosphere in the Fraunhofer zone are investigated. A comparison of experimental fluctuation histograms for the polar and azimuth angles with theoretical distribution laws shows a fair qualitative agreement between them. (auth)

34419 NUMERICAL SOLUTION OF THE INVERSE PROBLEM OF OBLIQUE ELECTROMAGNETIC SOUNDING OF THE IONOSPHERE. Barashkov, A. S.; Dmitrieev, V. I. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 219-222(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 261-264(1974).

The solution of the inverse problem of radio wave reflection from the ionosphere, i.e., determination of ionospheric characteristics from the results of oblique soundings, is investigated. (auth)

34420 SELF-MODULATION OF A STRONG ELECTROMAGNETIC WAVE DURING PARAMETRIC PLASMA EXCITATION. Vas'kov, V. V. Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 232-235(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 277-281(1974).

The modulation of an ordinary wave appearing as a result of the excitation of a parametric instability in the plasma is investigated. (auth)

34421 USE OF A COMPOUND SIGNAL TO INCREASE THE RESOLUTION OF AN IONOSPHERIC STATION. Namazov, S. A.; Vasil'eev, K. N.; Vasil'eev, G. V.; Ryzhkina, T. E.; Krivenko, V. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 236-239(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 282-286(1974).

A block diagram and description of the operation of an ionospheric station with a high altitude resolution are presented. The principle of compression of a compound signal with linear frequency modulation is used to ensure high resolution. It is demonstrated that it is possible, in principle, to increase altitude resolution by approximately one order of magnitude compared to standard ionosondes with a pulse duration of 100 μsec. (auth)

34422 PROBLEM OF HELIUM DISTRIBUTION IN THE UPPER ATMOSPHERE. Antonova, L. A.; Ivanov-Kholodnii, G. S. (Inst. of Applied Geophysics, Moscow). Geomagn. Aeron. (USSR) (Eng. Transl.); 14: No. 2, 240-243(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 287-292(1974).

A mechanism is proposed for explaining the helium profiles with a much sharper drop in concentration with height that follows from the barometric relation. These profiles were measured at heights of 150 to 200 km in mass-spectrometer experiments. (auth)

34423 EXCITATION OF ATMOSPHERIC LUMINESCENCE THROUGH IONIZATION BY SOLAR RADIATION. Krasnopol'skii, V. A. (Inst. of Space Research, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 244-248(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 293-299(1974).

The intensity and vertical profile of the daytime emission of the first and second negative O_2^+ systems, of 7320 Å and 2470 Å O^+ multiplets, of the Meinel N_2^+ system are computed for different solar zenith angles at moderate solar activity. The charge-exchange process between O^+ (^2D) and N_2 is discussed. (auth)

34424 IRREGULAR GEOMAGNETIC PULSATIONS AND RADAR AURORAS AS A RESULT OF THE TURBULENCE OF THE POLAR ELECTROJET. Shaftan, V. A.; Voshchina, L. K. (Inst. of Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 262-265(1975).

Translated from Geomagn. Aeron.; 14: No. 2, 316-320(1974).

It is demonstrated that the intensity of irregular geomagnetic pulsations (T ~10 sec) and the location of diffuse radar auroras with respect to the SPP recording point and closely related. The assumption that small-scale current elements at E-layer heights form a population agrees with the observed characteristics of SPP of the Pi type and with the movements of radar auroras. (auth)

34425 CHARACTERISTICS OF THE LATITUDINAL DISTRIBUTION OF GEOMAGNETIC PULSATIONS OF THE Pi 1 TYPE. Kalisher, A. L.; Popov, A. N.; Solov'eev, S. I.; Chernous, S. A. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 272-275(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 328-331(1974).

The spatial distribution of geomagnetic Pi 1 pulsations is investigated on the basis of the data of the Omega-2 experiment. The latitudinal profiles of the amplitudes of irregular pulsations are constructed. The relation of the maximum in the latitudinal Pi 1 distribution to the position of the zone of pulsating auroras is examined. (auth)

34426 RELATION BETWEEN THE DYNAMIC SPECTRA OF GEOMAGNETIC Pi 2 PULSATIONS AND THE MOVEMENT OF AURORAS. Raspopov, O. M.; Koshelevskii, V. K.; Starkov, G. V. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 276-279(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 332-336(1974).

The relation of the dynamic spectra of Pi2 pulsations to the movement of auroral arcs and the change in the position of emission regions at the instant of Pi2 generation is demonstrated. The large-scale E field in the magnetosphere is estimated from the descending branch of the dynamic spectrum (from the decrease in the period). (auth)

34427 FLUXES OF PRECIPITATING ELECTRONS IN THE UPPER MIDLATITUDE ATMOSPHERE. Tulinov, V. F.; Feygin, V. M. (Central Aerological Observatory, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 181-183(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 214-217(1974).

The results are reported of long-term rocket investigations of fluxes of "precipitating" electrons in the upper atmosphere (at heights to 160 km) at middle latitudes. The energy spectra of electrons in a broad energy interval and the scales of variation of the intensity of precipitating electrons in the upper midlatitude atmosphere are determined. Definite patterns of behavior of precipitating-electron fluxes in various periods of solar and geomagnetic activity are established. (auth)

34428 INTENSITY CORRELATIONS OF THE 4278-A N_2^+(0-1) FIRST NEGATIVE BAND AND 5875-A EMISSIONS IN AURORAS. Sears, R. D. (Lockheed Palo Alto Research Lab., CA). J. Geophys. Res.; 80: No. 1, 215-218(1 Jan 1975).

Simultaneous photometric observations of emission intensities in the 4278-Å N_2^+(0-1) first negative band and in the 5875-Å spectral region were made at Poker Flat, Alaska, for a short period during March 1972. Intensities measured in the 5875-Å region, where the $(2p^3P-3d^3D)$ transition of He is expected to appear as a result of alpha particle precipitation, exhibited a nearly constant ratio of $1/_{20}$ of the 4278-Å N_2^+ band emission intensity over a wide intensity range. The observed emission in the 5875-Å region is attributable mainly to emission from strong lines of the O_2^+(2-2) first negative band and the N_2(9-5) first positive band. No evidence was found for emission from He. The existence of time-varying auroral emission of presumably molecular origin, in addition to the background emission contributed by OH bands near the 5876-Å He transitions, places even more severe constraints upon photometric detection and identification of the auroral He emission than were previously anticipated. It is concluded that auroral He emission intensities in the 5875-Å spectral region must greatly exceed $1/_{20}$ of the 4278-Å intensity in order to be measured adequately by photometric techniques. (auth)

34429 BLANKETING SPORADIC E LAYER NEAR THE MAGNETIC EQUATOR. Chandra, H.; Rastogi, R. G. (Physical Research Lab., Ahmedabad, India). J. Geophys. Res.; 80: No. 1, 149-153(1 Jan 1975).

A study of the ionograms obtained at Kodaikanal (dip latitude 1.7°N) during the period 1954–1966 has shown that the daily variation of the occurrence of the blanketing type of E_s (E_{sb}) has a major peak around 1700 LT in the evening and a minor peak around 0800 LT in the morning and is practically inhibited around midday hours when the electrojet currents are maximum. Further, E_{sb} is most frequent during local summer months and in years of minimum solar activity. In individual cases, E_{sb} occurs during the period of very weak or reversed electrojet currents. The ionospheric drifts during these occasions show predominantly a north–south component. It is suggested that the equatorial E_{sb} is due to the transport and accumulation of long-lived metallic ions from tropical latitudes to the magnetic equator by equatorward winds during the period when the electrojet currents are very weak and the upward Hall polarization field is thus absent. (auth)

34430 TWILIGHT ENHANCEMENT OF λ5577-A AIRGLOW. Schaeffer, R. C. (Fritz Peak Observatory, Boulder, CO). J. Geophys. Res.; 80: No. 1, 154-160(1 Jan 1975).

The measurement of [O I] λ5577-Å airglow intensities in the morning and evening twilights with a Fabry–Perot interferometer has revealed an enhancement with an apparent seasonal variation. The enhancement is found to emanate from the F region of the ionosphere and is well accounted for in terms of the dissociative recombination of O_2^+ and F region electrons. It is shown that no other mechanism for the excitation of $O(^1S)$ atoms can be expected to give rise to a significant twilight enhancement. In addition, the results of earlier ground-based studies of the twilight green line airglow by other authors are reviewed critically with reference to the present results. (auth)

Magnetospheric Phenomena

Refer also to abstracts 34345, 34371, and 34372.

34431 (N-74-32184) THEORETICAL MODEL OF THE WAVE–PARTICLE INTERACTION OF PLASMA IN SPACE. Final Technical Report. Wu, S. T.; Hung, R. J. (Alabama Univ., Huntsville (USA). School of Graduate Studies and Research). Jun 1974. Contract NAS8-29501. 52p. (NASA-CR-120411; UAH-RR-155). NTIS $5.75.

A theoretical model, based on the kinetic theory for the perturbation of plasma in the magnetosphere, is proposed to study the observed disturbances which are caused by both natural and artificial sources that generate wave-like perturbations propagating around the globe. The proposed model covers the wave propagation through a media of transitional (from collisional to collisionless) fully ionized magnetoactive plasma. A systematic formulation of the problem is presented and the method of solution for the transitional model of magnetosphere is discussed. The possible emission of hydromagnetic waves in the magnetosphere during the quiet and disturbed time are also discussed. (auth)

34432 DISTRIBUTION OF THE INTENSITY OF GEOMAGNETIC Pc3 PULSATIONS OVER THE EURASIAN CONTINENT. Baranskii, L. N.; Piyasova-Bakunina, T. A.; Vinogradov, P. A.; Loginov, G. A.; Popov, A. N. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 280-282(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 337-339(1974).

The average distribution pattern of Pc3 pulsations on the side of the earth facing the sun is constructed from synchronous Pc3 observations at 22 stations in Eurasia. The Pc3 pulsations are found to have two intensity maxima, a high-latitude maximum ($\Phi' \approx 70°$) and a midlatitude maximum ($\Phi' \approx 55–60°$). (auth)

34433 NONSTATIONARY PARTICLE DISTRIBUTION IN THE MAGNETOSPHERE AND GENERATION OF PERIODIC EMISSIONS IN THE VLF AND SPP RANGE. Bespalov, P. A.; Trakhtengerts, V. Yu. (Gorky Radiophysics Inst., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 266-271 (1974).

Translated from Geomagn. Aeron.; 14: No. 2, 321-327(1974).

The possible formation on nonstationary, periodically varying energetic-particle distributions in the magnetosphere during the explosive phase of a magnetospheric substorm is discussed. Such distributions may generate spectra with a discrete structure in the range of VLF emissions and SPP. (auth)

34434 EFFECT OF THE GEOMAGNETIC FIELD INCLINATION ON THE REFLECTION FROM THE IONOSPHERE OF GUIDED HYDROMAGNETIC WAVES. Van'yan, L. L.; Kozhevnikov, A. A. (Inst. of Space Research, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 156-261(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 309-315(1974).

The interaction of guided Alfvén waves with the ionosphere is investigated. An expression of the reflection coefficient is obtained for an arbitrary angle of the geomagnetic field inclination toward the ionosphere. The ionospheric Hall current system is found to affect the guided reflected wave. (auth)

34435 INTERACTION OF MHD WAVES WITH THE MAGNETOSPHERE. Best, A.; Lehmann, H. R.; Treumann, R. (Central Inst. of Solar-Terrestrial Physics, Berlin). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 249-255(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 300-308(1974).

The interaction of MHD waves with the magnetosphere is discussed. The magnetopause is regarded as a tangential discontinuity. An attempt is made to estimate the simultaneous effect of electric conductivity and viscosity. (auth)

34436 COMPARISON OF MAGNETIC FIELD INHOMOGENEITIES OF VARIOUS CURRENT SYSTEMS. Banukhin, L. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 324-325(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 383-384(1974).

Maxwell (1873) gave a general solution of a system of four ring currents producing a more homogeneous magnetic field than could possibly be produced earlier by the known two-coil system of Helmholtz. Since then more than a score of different four-sectional current systems of circular, polygonal, and square shape have been proposed. Most of the known systems were examined by Shtamberger (1972), but no graphic comparison was made between the inhomogeneities of the magnetic fields of the various systems. Here the field inhomogeneities of various systems are compared. (WDM)

34437 SOURCES OF CYCLIC VARIATIONS OF THE HORIZONTAL COMPONENT OF THE GEOMAGNETIC FIELD, SEPARATED FROM AVERAGE ANNUAL VALUES. Rivin, Yu. R. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.), 14: No. 2, 320-321(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 379(1974).

The 11-year cyclic variations of H have been explained by the contribution of magnetic activity to the average annual field values. The assumption has been voiced that processes associated with current systems responsible for daily geomagnetic field

variations may be the reason for the manifestation of such a periodicity. To determine whether these explanations and assumptions are correct, the H variations at Vysokaya Dubrava in 1938-1971 were investigated. (WDM)

34438 SEPARATION OF THE FIELD OF Sq(H) VARIATIONS INTO LT AND UT COMPONENTS. Pogrebnoy, V. N. (Ionospheric Sector, Kazakh, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 318-320(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 377-378(1974).

The possibility is demonstrated of separating the S_q(H) field into LT and UT parts over a short time interval (individual days) on the basis of the unique properties of the pattern of S_q(H) variations identified at Alma-Ata and Novokazalinsk. (WDM)

34439 SEPARATION OF FIELD OF Sq VARIATIONS INTO POLOIDAL AND TOROIDAL PARTS. Berdichevskii, M. N.; Faynberg, E. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 14: No. 2, 315-318(1974).

Translated from Geomagn. Aeron.; 14: No. 2, 373-376(1974).

It is advisable to begin experiments on the separation of the variable geomagnetic field into poloidal and toroidal parts with quiet-day solar daily variations. Despite the fact that the morphology of S_q variations has been studied fairly well, there is as yet no consensus on the magnitude of the toroidal part of the field. Therefore it is appropriate to investigate this problem further. (WDM)

34440 OBSERVATIONS OF LOW-ENERGY ELECTRONS UPSTREAM OF THE EARTH'S BOW SHOCK. Reasoner, D. L. (Rice Univ., Houston). J. Geophys. Res.; 80: No. 1, 187-190(1 Jan 1975).

Observations of electron fluxes with a lunar-based electron spectrometer when the Moon was upstream of the Earth have shown that a subset of observed fluxes are strongly controlled by the interplanetary magnetic field (IMF) direction. The fluxes occur only when the IMF lines connect back to the Earth's bow shock. Observed densities and temperatures were in the ranges 2 to 4×10^{-3} cm^{-3} and 1.7 to 2.8×10^6 °K. It is shown that these electrons can account for increases in effective solar wind electron temperatures on bow shock connected field lines, which have been observed previously by other investigators. It is further shown that if a model of the bow shock with an electrostatic potential barrier is assumed, the potential can be estimated to be 500 V. (auth)

34441 MAGNETIC FIELD DEPRESSION AT THE EARTH'S SURFACE CALCULATED FROM THE RELATIONSHIP BETWEEN THE SIZE OF THE MAGNETOSPHERE AND THE Dst VALUES. Su, S. Y.; Konradi, A. (Johnson Space Center, Houston). J. Geophys. Res.; 80: No. 1, 195-199(1 Jan 1975).

A linear relationship between the hourly Dst value and the inverse of the cube of the magnetosphere subsolar distance R_1^{-3} from Explorer 12 satellite boundary observations has been found to exist for geomagnetically quiet times and slightly disturbed periods. The proportionality constant between the Dst and R_1^{-3} is found to be 1.40 times the theoretical value predicted by Mead but remains unchanged for different geomagnetic conditions. The only changes are the amount of the field depression due to the ring current registered in the Dst values. The field depression at the Earth's surface is found to be $-19\ \gamma$ from the quiet time ring current and $-44\ \gamma$ from the slightly disturbed time ring current. (auth)

34442 DOUBLE CURRENT LAYERS IN THE POLAR CUSP. Bahnsen, A.; D'Angelo, N.; Hansen, A. M. (Danish Space Research Inst., Lyngby). J. Geophys. Res.; 80: No. 1, 201-202(1 Jan 1975).

A possible explanation for the origin of double current layers in the polar cusp is advanced. It is based on the Kelvin-Helmholtz turbulence resulting from ion-sheared flow. (auth)

34443 TRIGGERING CAPABILITY OF OBLIQUELY PROPAGATING WHISTLERS. Brinca, A. L. (Instituto Superior Tecnico, Lisbon). J. Geophys. Res.; 80: No. 1, 203-209(1 Jan 1975).

The nonlinear interaction between obliquely propagating whistlers and energetic electrons in fundamental gyroresonance is studied through numerical simulation. In analogy with the parallel whistler case, phase bunching occurs in the perpendicular velocities of the resonant electrons. The computed organized current brought about by the bunching suggests that obliquely propagating whistlers have the capability to trigger emissions through the gyroresonance interaction. (auth)

34444 VELOCITY SHEAR AND THE E × B INSTABILITY. Perkins, F. W.; Doles, J. H. III. (Bell Lab., Whippany, NJ). J. Geophys. Res.; 80: No. 1, 211-214(1 Jan 1975).

An E × B instability in the ionospheric F region is stabilized by velocity shear introduced by a modest component of the electric field in the direction of the density gradient. (auth)

34445 MODEL FOR GENERATION OF BOW-SHOCK-ASSOCIATED UPSTREAM WAVES. Fredricks, R. W. (TRW Systems Group, Redondo Beach, CA). J. Geophys. Res.; 80: No. 1, 7-17 (1 Jan 1975).

It is shown that proton streams reflected from a bow shock structure that partially organizes their distribution in gyrophase in such a way that the reflected beam distribution function has the form $F_b(v_\perp^2, v_\parallel, \phi)$, where ϕ is the phase angle for motions perpendicular to the solar-wind field B_0, are capable of driving a left-hand (Alfvén) wave at rest frame frequencies $\omega < \Omega_i$. The driven wave amplitude becomes a sharply peaked function of $\omega/\Omega_i = \chi$, and the location $\chi = \chi_0$ and peak amplitude of the wave $B(\chi_0)$ depend critically on the ratio of beam speed V_b to the Alfvén speed C_A and on the value of solar wind β. Driven wave amplitudes are estimated to be up to several gammas for beam speeds (in the rest frame) of $V_b \sim 2V_{SW}$. The observed frequency and polarization depend upon Doppler shifting due to solar wind flow, and observed polarization could be either left-hand or right-hand depending upon the vector properties of the solar-wind velocity and magnetic fields. (auth)

34446 ELECTROSTATIC AND ELECTROMAGNETIC TURBULENCE ASSOCIATED WITH THE EARTH'S BOW SHOCK. Rodriguez, P.; Gurnett, D. A. (Univ. of Iowa, Iowa City). J. Geophys. Res.; 80: No. 1, 19-31(1 Jan 1975).

The electric and magnetic field spectral densities of plasma waves in the Earth's bow shock have been measured in the frequency range 20 Hz to 200 kHz by using two 16-channel spectrum analyzers on the Imp 6 spacecraft. The electric field spectrum in the bow shock consists of two distinct components: one component has a broad peak typically centered between 200 and 800 Hz with an average (5.12-s time constant) spectral density at the peak of about 10^{-9} V^2 m^{-2} Hz^{-1}, and the other component increases monotonically with decreasing frequency approximately as $f^{-(2.0\pm0.5)}$ and has an average spectral density of about 3.0×10^{-9} V^2 m^{-2} Hz^{-1} at 36.0 Hz. The magnetic field spectrum in the shock has only one component that increases monotonically with decreasing frequency approximately as $f^{-(4.0\pm0.5)}$ and has an upper cutoff frequency near the local electron gyrofrequency. This magnetic field spectrum appears to be associated with the monotonic component of the electric field spectrum. The electric to magnetic energy density ratio ϵ_E/ϵ_B of this noise is about 10^{-3} to 10^{-4}, which is consistent with the energy density ratio expected for electromagnetic whistler mode waves in the bow shock. The broad peak in the electric field spectrum between 200 and 800 Hz has a large electric to magnetic energy density ratio, $\sim 10^2$ to 10^3, indicating that this component consists of almost purely electrostatic waves. Electrostatic noise with a spectrum similar to the turbulence in the shock but with lower intensities is observed throughout the magnetosheath region downstream of the shock. This magnetosheath electric field turbulence often includes many bursts with a distinct "parabolic" frequency–time variation on a time scale of a few seconds. Spin modulation measurements of the electric field direction show that the electric field vectors in both the shock transition region and the magnetosheath region are preferentially oriented parallel to the static magnetic field direction. The electric field of upstream electron plasma oscillations also is oriented parallel to the static magnetic field. (auth)

34447 EQUATIONS FOR MAGNETOSPHERIC CONVECTION AND A SOLUTION FOR POLAR CAP FLOWS. Atkinson, G. (Communications Research Centre, Ottawa). J. Geophys. Res.; 80: No. 1, 32-36(1 Jan 1975).

Equations describing the magnetospheric flow in regions of equipotential convection are developed for the case of uniform ionospheric conductivity and zero cross-field current inside the regions. The approach is equivalent to that of Vasyliunas, since the assumptions are those of equipotential convection. Flux tubes are regarded as fluid elements, and terms appear in the equations, corresponding to the stress due to the interaction of a flux tube with its neighbors and to stresses transmitted through the ends. The convective velocity is found to be expressible as the gradient of a two-dimensional potential that obeys either Laplace's or Poisson's equation. The equations are applied to flow in the polar caps to determine what type of applied outer magnetospheric force produces the observed flows. It is required that flux tubes anchored near the outer boundary of the polar cap be subject to a shear force relative to other polar cap flux tubes to produce the narrow latitude-limited flows often observed. (auth)

34448 SIMULTANEOUS PARTICLE AND FIELD OBSERVATIONS OF FIELD-ALIGNED CURRENTS. Berko, F. W. (Goddard Space Flight Center, Greenbelt, MD); Hoffman, R. A.; Burton, R. K.; Holzer, R. E. J. Geophys. Res.; 80: No. 1, 37-46(1 Jan 1975).

Simultaneous measurements of low-energy precipitating electrons and magnetic fluctuations from the low-altitude polar-

orbiting satellite Ogo 4 were compared. Analysis of the two sets of experimental data for isolated events led to the classification of high-latitude field-aligned currents as purely temporal or purely spatial variations. Magnetic field disturbances calculated by using these simple current models and the measured particle fluxes were in good agreement with measured field values. Although fluxes of electrons of greater than 1 keV were detected primarily on the night side, magnetometer disturbances indicative of field-aligned currents were seen at all local times, in both the visual auroral regions and the day side polar cusp. Thus electrons with energies of less than ~1 keV are the prime charge carriers in high-latitude day side field-aligned currents. The satellite measurements are in good agreement with previously measured field-aligned current values and with values predicted from several models involving magnetospheric field-aligned currents. (auth)

34449 LOCAL TIME VARIATIONS OF PARTICLE FLUX PRODUCED BY AN ELECTROSTATIC FIELD IN THE MAGNETOSPHERE. Kivelson, M. G. (Univ. of California, Los Angeles); Southwood, D. J. J. Geophys. Res.; 80: No. 1, 56-65(1 Jan 1975).

The local time variations of particle distributions, which can be produced by the sudden enhancement of a cross-tail electric field, are examined by using adiabatic theory. The strong coupling between acceleration, inward motion, and east–west drift is emphasized. The model is used to interpret recent measurements of delay times of newly accelerated electrons at different local times at geostationary orbit. Observations of the asymmetric storm time "ring current" are interpreted in terms of the model without invoking particle loss. (auth)

34450 ANGULAR DISTRIBUTIONS OF ELECTRONS IN INVERTED V SUBSTRUCTURES. Venkatarangan, P.; Burrows, J. R.; McDiarmid, I. B. (National Research Council of Canada, Ottawa). J. Geophys. Res.; 80: No. 1, 66-72(1 Jan 1975).

Data from the energetic particle detectors on board the low-altitude polar-orbiting satellite Isis 2 are presented to describe several features of the low-energy (0.15 to 9.7 keV) electrons in "inverted V" substructures. The measurements show that, frequently, the fluxes of electrons in the inverted V events peak at ~90° pitch angle. In addition to this principal peak the electron fluxes also have a tendency to once again increase at smaller pitch angles (usually $\lesssim 30°$). This tendency becomes more significant at lower electron energies. On the basis of the measurements it is suggested that acceleration processes other than parallel electric fields are mainly responsible for the formation of at least some of the observed inverted V substructures and that such inverted V events probably occur on closed field lines in the magnetosphere. (auth)

34451 AVERAGE CHARACTERISTICS OF MAGNETOSPHERIC ELECTRONS (150 eV TO 200 keV) AT 1400 km. McDiarmid, I. B.; Burrows, J. R.; Budzinski, E. E. (National Research Council of Canada, Ottawa). J. Geophys. Res.; 80: No. 1, 73-79 (1 Jan 1975).

Data from about 1100 passes of the polar orbiting satellite Isis 2 were used to determine average intensities and energies of electrons as functions of magnetic local time and invariant latitude for energies above 150 eV. It was found that at any local time the average energy of electrons (in the range 150 eV to 9.6 keV) is a minimum at or near the latitude of the average position of the trapping boundary for 35-keV electrons but that the deepest minimums occur at local times of 0300 and 1600. It was also found that the highest average fluxes of 150-eV electrons occur at 1500 MLT at the boundary and at 0300 MLT inside the boundary. On the basis of these measurements it is suggested that magnetosheath particles enter the closed field region of the magnetosphere at all local times and that typically there is some energization associated with this entry. Entry is least likely at local times before noon, and energization is greatest at local times before midnight. It is further suggested that at least two processes, convection and possibly a diffusive mechanism, are involved in the entry of magnetosheath plasma to the magnetosphere. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 32496, 33792, 34015, 34016, 34019, 34066, 35040, and 35047.

34452 (JAERI-M-5567, pp 153-166) HEAVY ION SOURCE. Fukuzawa, F. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

A review is given of fundamental processes which lead to the production of multiply charged ions by electron-atom collision in heavy ion sources. Experimental and theoretical results on ionization potentials, ionization cross sections, direct ejection, inner shell ionization and confinement time are discussed in order to obtain the knowledge of ionic populations in ion sources. Electron affinities are important quantities for production of negative ions, and briefly surveyed. (auth)

34453 (JAERI-M-5567, pp 192-197) KYOTO BEAM-PLASMA TYPE ION SOURCE. Takagi, T.; Yamada, I.; Ishikawa, J. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

A new beam-plasma type ion source has been designed and evaluated to obtain a high density and high current ion beam. A highly dense plasma which is stable in density is produced by a beam-plasma discharge, in which the gas is ionized very effectively by the microwave power of the electron beam through the beam-plasma interactions. In our experimental apparatus the plasma density of about 10^{11} cm^{-3} has been obtained. This value will increase by a factor of 10^1-10^2 with the electron beam current and the magnetic field. This suggests that an ampere of ion beam can be obtained by the ion source in the proper operation. The electron beam is injected near the ion extractor, resulting in both a high intensity and highly neutralized, well confined ion beam. The very low normalized emittance of 3.8×10^{-2} rad·m was obtained for the 1 mA ion beam. The operation for the multiply-charged ion source is also given. (auth)

34454 (LA-tr-75-5) MECHANISM OF SECONDARY ION EMISSION. Kishinevskii, M. E. 1973. Translated by Helen J. Dahlby from Preprint IIaF-116-73. 10p. Dep. NTIS $4.00.

The phenomenon of secondary ion emission is discussed. Interest in this phenomenon has grown greatly recently, in connection with the creation of powerful ion surface-plasma sources. A mechanism is proposed for secondary ion emission, and numerical calculations are carried out on an electronic computer of the probability of formation of a negative hydrogen ion as a result of secondary ion emission. (auth)

34455 SURFACE COMPOSITIONAL ANALYSIS USING LOW ENERGY ION BOMBARDMENT INDUCED EMISSION PROCESSES. Colligon, J. S. (Univ. of Salford, Eng.). Vacuum; 24: No. 9, 373-388(Sep 1974).

When low energy (100 eV to a few keV) ions interact with a target surface several secondary emission processes occur, each of which may be studied to give information on the nature of the bombarded material. Surface analysis techniques utilizing sputtering of atoms, ejection of excited atoms (and subsequent photon emission), ionic emission (SIMS) and electron emission are described with emphasis on the basic mechanisms and theoretical models of the ejection processes rather than their application. Limitations of the methods are discussed, in particular when applied to quantitative compositional analysis. In conclusion, the emission techniques most suitable for different types of analytical measurements are discussed. (auth)

34456 VODIANOI: A GENERATOR OF A POWERFUL BEAM OF RELATIVISTIC ELECTRONS. Boyarintsev, E. L.; Kapitonov, V. A.; Kornilov, V. A. (Inst. of Nuclear Physics, Novosibirsk, USSR). Dokl. Akad. Nauk SSSR; 217: No. 4, 808-811(1974). (In Russian).

A high current relativistic electron beam generator was constructed and its design is described in detail. Very pure water compressed under 100 atm to increase its electrical stability is used to insulate the pulse-shaping lines. (JSR)

34457 ION SURFACE INTERACTION, SPUTTERING, AND RELATED PHENOMENA. Conference Held at Munich, Germany, September 24-27, 1972. Behrisch, R.; Heiland, W.; Poschenrieder, W.; Staib, P.; Verbeek, H. (eds.). New York; Gordon and Breach, Science Publishers, Inc. (1973). 329p. (CONF-7209125-). $33.00.

This volume contains the proceedings of an international conference. The main emphasis is on the physics of scattering of single-crystal, polycrystalline, and amorphous materials. Surface damage, blistering, secondary ion electron and photon emission, and ion backscattering are also covered. Separate abstracts were prepared for 47 of the papers. (DLC)

For abstracts of individual papers see: 32495-32497, 33705, 33745, 33792, 34010-34014, 34458-34491, 35050, and 35051.

34458 ANISTROPIC EMISSION IN SINGLE CRYSTAL SPUTTERING: MEASUREMENTS ON HCP SINGLE CRYSTALS. Hofer, W. O. (Gesellschaft fuer Strahlen und Umweltforschung mbH, Munich). pp 7-14 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The ejection characteristics of single crystals of zinc, magnesium (hcp), and aluminum (fcc) were determined by bombarding various crystal surfaces with a beam of inert gas ions. The energy of the bombarding ions varied between 10 and 40 keV. The sputtered particles were collected on cooled, hemicylindrical metal collectors; with the help of an electron probe the thickness of the deposit was measured. Pronounced anisotropic emission was observed in all cases, although random emission comprises the major part of the total ejection. By comparing the ⟨20$\bar{2}$3⟩ ejection, which is produced by pure surface collisions, and the ⟨11$\bar{2}$0⟩ ejection, where focusing collisions are involved, it is deduced that surface collisions are mainly responsible for the anisotropic emission. The width of both emission distributions increases linearly to the same extent in the temperature regime between 100 and 370°K. The agreement of the Mg ⟨11$\bar{2}$0⟩ ejection with the ⟨110⟩ ejection from an aluminum (111) single crystal is good and thus allows a comparison with the gold ⟨110⟩ ejection reported in the literature. The assisted focusing ejection in ⟨0001⟩, which is very pronounced in zinc single crystals and strongly influences the ⟨20$\bar{2}$3⟩ ejection from the basal plane, does not show up in magnesium. No. ⟨111⟩ ejection occurred in aluminum either. In both cases the weak repulsive potential of the low-Z atoms accounts for the lack of this preferential emission. (12 fig) (auth)

34459 DEPENDENCE OF THE SPACE DISTRIBUTION OF PARTICLES SPUTTERED FROM MONOCRYSTALLINE COPPER ON THE ION INCIDENCE ANGLE. Bukhanov, V. M.; Morozov, V. G.; Yurasova, V. E. (Moscow State Univ.). pp 15-18 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The dependence of the angular distribution of atoms sputtered from the (001) monocrystalline copper face on the incidence angle of 22-keV neon ions was studied. Use is made of well-known ideas defining the observed distribution as a result of superposition of the directed atomic yield along the close-packed axes and of the random yield along all directions. Values obtained for the relative contribution of the directed and random sputterings indicate that the dependence of these values on the ion incidence angle is distinctly anisotropic. The yield of the directed sputtering had a minimum value when the incidence directions of the bombarding ions coincided with the low-index crystallographic axes. In addition, the width of ⟨011⟩ and [001] pattern spots was also found to be an anisotropic function of the ion incidence angle. The spots have the smallest width when the direction of ion incidence coincides with the low-index axes. The observed dependences are discussed on the basis of the focusing mechanism of the sputtered atom yield. (auth)

34460 DEPTH ANALYSIS OF CLEAVED MICA SURFACES MONITORED BY AUGER SPECTROSCOPY. Staib, P. (EURATOM, Garching, Ger.). pp 19-21 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

Vacuum cleaved mica surfaces (muscovite) are etched by a 500-eV argon ion beam. The surface composition of the cleaved surface is known from the succession of atomic layers in the crystal. The surface structure and its chemical composition are analysed by LEED and Auger electron spectroscopy. It is shown that the bombardment quickly destroys the crystal structure, making an accurate depth analysis of the sample impossible. (auth)

34461 DEPTH DISTRIBUTIONS OF IMPLANTED ATOMS UNDER THE INFLUENCE OF SURFACE EROSION AND DIFFUSION. Biersack, J. P. (New York Univ.). pp 29-36 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

Shallow range distributions are altered significantly by diffusion and surface erosion. It is shown that the simultaneous processes of implantation, diffusion, and surface erosion can be described by a second-order differential equation which is mathematically tractable and yields general results in terms of analytical functions. The resulting depth distributions depend on one parameter only which is a combination of the mean particle range, the diffusion coefficient, and the velocity of surface erosion (e.g., sputtering). The theory is applied to practical cases, e.g., implantation of plasma particles in the wall of fusion reactors, or solar wind ions in the surface of meteorite materials. (6 fig) (auth)

34462 SPUTTERING OF OXIDES. I. A Survey of the Experimental Results. Kelly, R.; Lam, N. Q. (McMaster Univ., Hamilton, Ont.). pp 37-46 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The sputtering behavior of oxides is now fairly well understood in 12 cases. Three categories can be recognized, with some oxides belonging to more than one category. The eight oxides Al_2O_3, MgO, Nb_2O_5, SiO_2, Ta_2O_5, TiO_2, UO_2, and ZrO_2 have sputtering coefficients as expected from Sigmund's theory of collisional sputtering, at least provided the surface binding energy can be identified with the heat of atomization. The four oxides MoO_3, SnO_2, V_2O_5, and WO_3 show high and (except possibly with SnO_2) temperature-dependent sputtering coefficients such that the inferred surface binding energies are significantly less than the heats of atomization. For example, V_2O_5 has $S \approx 12.7$ atoms/ion for 10-keV Kr, so that E_b is apparently 1.3 eV/atom as compared with 5.7 eV/atom for atomization. This is taken as evidence for thermal sputtering. The five oxides MoO_3, Nb_2O_5, TiO_2, V_2O_5, and WO_3 show preferential oxygen sputtering, such that they first amorphize, then lose oxygen, and finally crystallize as the phases MoO_2, NbO, Ti_2O_3, V_2O_3, and $W_{18}O_{49}$. A comparison between corresponding oxides and metals is also possible with the information available. The main result is that the ratio S_{oxide}/S_{metal} is normally greater than unity (Al_2O_3, MgO and TiO_2 are exceptions), whereas the ratio (S_{oxide}/S_{metal}) (mole fraction of metal in the oxide) is normally less than unity (V_2O_5 is an exception). (6 tables, 73 references) (auth)

34463 SPUTTERING AND BACKSCATTERING OF keV LIGHT IONS BOMBARDING RANDOM TARGETS. Weissmann, R. (EURATOM, Garching, Ger.); Sigmund, P. pp 47-54 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

Range and damage distributions were calculated for light ions slowing down in heavy targets in the energy region where electronic stopping is dominating and approximately proportional to velocity. Following Schiøtt's approach, well-known integral equations for spatial moments were approximated by differential equations, and the latter solved by numerical integration. Moments over the two distributions up to third order were obtained, and the distributions were constructed by use of the Edgeworth expansion. From the profiles, backscattering coefficients and relative sputtering yields were determined. Comparison is made with previous theoretical results, computer simulation and experimental results. An improved calculation of the sputtering yield of light ions bombarding a thin film is also presented. (8 fig, 33 references) (auth)

34464 CONTRIBUTIONS OF BACKSCATTERED IONS TO SPUTTERING YIELDS DEPENDING ON PRIMARY ION ENERGY. Weissmann, R.; Behrisch, R. (EURATOM, Garching, Ger.). pp 55-61 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

Sputtering yields for 33-150 keV protons normally incident on Cu films deposited on different backing materials were measured. The decrease of the Cu-film thickness was determined by Rutherford backscattering. As the used base materials have different backscattering intensities, the contribution to sputtering yield by incident ions and by the ions backscattered to the surface within the material could be separated. It was found that the relative contribution to total sputtering yield by the backscattered ions increases slowly for protons in the energy range from 50 to 150 keV. For energies lower than 50 keV the sputtering yields are determined by the special geometry of the target sandwich used here. (auth)

34465 SPUTTERING-YIELD STUDIES ON SILICON AND SILVER TARGETS. Andersen, H. H.; Bay, H. L. (Univ., Aarhus, Denmark). pp 63-70 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The sputtering yield of vacuum-deposited silicon and silver targets were measured with 15 different 45-keV ions throughout the periodic system. The dependence of the yield on the projectile atomic number follows rather closely Sigmund's prediction, especially for silicon. The self-sputtering yield of silver was measured in the 30–500 keV energy range. Similar to what is known to be the case for other heavy particles on silver, the maximum of the yield was found to be much more pronounced than predicted by Sigmund's theory. This effect, together with small systematic deviations in the Z_1 dependence, is explained as being caused by nonlinear effects in very dense collision cascades. This point of view is strongly supported by a comparison of the sputtering yield per atom for irradiation with atomic and molecular ions. (10 fig) (auth)

34466 DOSE DEPENDENCE OF 45 keV V^+ AND Bi^+ ION SPUTTERING YIELD OF COPPER. Andersen, H. H. (Univ., Aarhus, Denmark). pp 71-75 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The sputtering yield of 45-keV V^+ ions on copper is found to decrease with increasing dose even for very large doses, whilst the yield of 45-keV Bi^+ ions on copper increases with increasing dose until approximately ten times the projected range of the Bi^+ ions has been sputtered away. The fate of the incoming V^+ and Bi^+ ions was investigated. A radiotracer technique showed that vanadium accumulated on the target surface, whilst bismuth diffused into the target, as was seen by means of Rutherford-scattering of light ions. (auth)

34467 VARIATION OF THE SPUTTERING YIELD OF GOLD WITH ION DOSE. Colligon, J. S.; Hicks, C. M.; Neokleous, A. P. Univ. of Salford, Eng.). pp 77-83 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

In an earlier publication it was noted that the sputtering yields of gold varied considerably over an initial bombardment period during which approximately 6×10^{16} ions/cm^2 struck the target surface; above this dose yields became constant and agreed reasonably well with other sources of data. The present work describes a modified version of the original apparatus which allows up to one hundred experiments to be carried out in one evacuation under better uhv conditions. 0–600 eV N_2^+ ions were used and, as the present technique allows measurement of total yields as low as 10^{12} atoms, a careful study of the sputtering yield-dose pattern has been possible. Scanning electron micrographs of the gold surface at various stages of the bombardment

indicate only slight surface roughening. A model is proposed based on the development of dislocation loops which could explain the relatively long recovery time in the 600-eV yield which follows a short bombardment at a lower energy. (9 fig) (auth)

34468 SPUTTERING YIELDS OF NIOBIUM BY DEUTERIUM IN THE keV RANGE. Eckstein, W.; Scherzer, B. M. U.; Verbeek, H. (EURATOM, Garching, Ger.). pp 85-87 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The sputtering yields of ~600 Å niobium films bombarded by 3-8 keV D^+ ions were measured. Rutherford backscattering of 150-keV H^+ ions was used as a probe to measure the decrease of film thickness due to sputtering. A sputtering yield of $S = 4 \times 10^{-3}$ atoms/ion was found which is only weakly dependent on the energy. The result is about a factor of two lower than expected from extrapolating measurements made by Sammers et al. at higher energies. The discrepancy may be due to differences in film structure, contamination by oxygen and/or differences in the measuring methods. (auth)

34469 ENERGY DISTRIBUTION OF PROTONS WITH PRIMARY ENERGY OF 15 keV BACKSCATTERED FROM A Ni SINGLE CRYSTAL. Eckstein, W.; Schaeffler, H. G.; Verbeek, H. (EURATOM, Garching, Ger.). pp 107-111 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

A nickel single crystal was bombarded with 15-keV protons incident in the vicinity of the ⟨110⟩ and ⟨100⟩ directions. The backscattered protons were energy-analysed with a spherical electrostatic analyzer which could be moved around the target. The energy resolution was $E/\Delta E = 140$. The surface peak and a very low scattering intensity from the bulk was observed in a channelling experiment. The latter intensity is zero within the experimental error in double alignment. In this case it can be deduced from the width of the surface peak that less than two atomic layers contribute to it. When the angle between a close-packed direction and the incident beam is increased, at first only the scattering intensity from the bulk increases. When a critical angle is exceeded, the surface peak increases as well. At the same time it broadens and shifts to lower energies. In addition, at energies below the surface peak new peaks in the backscattering spectra appear. Computer simulations indicate that backscattering in this energy range is governed to a great extent by multiple collisions. It is thus impossible to attribute to the observed peaks specific depths from which the backscattering occurs. The enhancement and shift of the surface peak is simulated by the calculations. They cannot, however, explain the observed structure in the spectra. (auth)

34470 INFLUENCE OF ION BOMBARDMENT INDUCED RADIATION DAMAGES IN THE CRYSTAL LATTICE ON THE ANGULAR REGULARITIES IN ION SCATTERING. Arifov, U. A.; Aliyev, A. A. (Inst. for Electronics, Tashkent). pp 113-116 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The paper examines the angular, spatial and energy distribution of ions scattered by various faces of silicon and germanium single crystals. It is shown that, due to the orderly arrangement of atoms in the crystal lattice, the orientation effects in the angular, spatial, and energy distributions are observed at temperatures exceeding the annealing temperature of ion bombardment induced radiation damage. At high temperatures of the sample a reduction of the anisotropy in the angular, spatial and energy distributions of scattered ions was observed which is due to the changing transparency of the crystal resulting from the thermal vibrations of atoms in the lattice. Results testify to the possibility of using the orientation dependences of phenomena occurring during the interaction of ions with crystals for determining the annealing temperature of ion bombardment damage and for studying the kinetics of the process of ion bombardment. Further studies could develop a technique for the quantitative estimation of ion bombardment damage in crystals and also in thin epitaxial films. (auth)

34471 ACCOMMODATION COEFFICIENTS FOR LOW-ENERGY IONS ON METAL SURFACES. Arifov, U. A.; Gruich, D. D.; Ermakov, G. E.; Parilis, E. S.; Turayev, N. Y.; Umarov, F. F. (Inst. for Electronics, Tashkent). pp 123-127 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The interaction of low-energy ions ($E = 3$ to 100 eV) with the surface of a solid cannot be treated in terms of gas dynamics. The scattering of particles at an energy of $E_0 > 20$ eV may be explained in terms of binary collisions with the atoms of the target. The validity of the single collision model with free surface atoms for medium energies from 10 to 100 eV and even down to 1 eV was confirmed on the basis of both experimental and computational data. This paper describes experimental studies of the secondary ion emission from the (100) and (110) faces of an Mo single crystal and both experimental and theoretical studies of alkaline ion accommodation coefficient on polycrystalline Mo within the energy range $E = 3$ to 50 eV with a varying direction of the primary ion beam from normal to the glancing angle of incidence ($\varphi = 0$ to 75°). On the basis of the retarding potential method using a spherical condenser whose central electrode was the target, the energy distribution of secondary ions was measured. Calculations were performed for the energy of scattered ions and the high energy portion of accommodation coefficient on the basis of single and double binary collisions using the Born–Mayer potential and taking into consideration the influence of adsorption forces at the surface of the target. (auth)

34472 MEASUREMENT OF THE BACK-SCATTERING OF FISSION FRAGMENTS FROM THIN METAL FILMS. Vetter, A.; Fiedler, G.; Guettner, K.; Schmidt, H. (Justus-Liebig Univ., Giessen, Ger.) pp 129-133 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The backscattering of ^{235}U fission fragments from thin polycrystalline gold and lead films was studied by transmission electron microscopy. This method gives information about the total reflection rate, the distribution of the reflection angles, and the penetration depth for low angles of incidence. Satisfactory agreement was obtained between Monte-Carlo calculations and experimental results. (auth)

34473 SECONDARY ION EMISSION OF ALLOYS IN RELATION WITH THEIR ELECTRONIC STRUCTURE. Blaise, G. (Paris Univ., Orsay, France). pp 147-152 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

When an atom crosses a metal-vacuum surface, the perturbation acting upon outer electronic shells produces excited states the energy of which exceeds, in some cases, the ionization energy of the atom; then, one deals with autoionizing states. A secondary positive ion emission process from metals and alloys is proposed, based upon the formation of auto-ionizing states. In such a process the ion yield K^+ of an element is proportional to the occupation probability of auto-ionizing states. This probability is closely connected to the density of states around the element inside the metal or alloy, in a small bandwidth energy near the Fermi level: the greater the fraction of valence electrons of the atom in this bandwidth, the higher the occupation probability will be. This connection explains enhancement observed experimentally in the ion emission of transition elements (from Ti to Cu) in dilute alloys. This effect is particularly noticeable when d electrons of transition elements are distributed in a virtual bound state which crosses the Fermi level as in the case of chromium in nickel matrix or transition elements in aluminium or copper matrix. (6 fig) (auth)

34474 INFLUENCE OF TEMPERATURE ON THE SECONDARY ION EMISSION OF A MONOCRYSTALLINE ALUMINUM TARGET. Laurent, R.; Slodzian, G. (Paris Univ., Orsay, France). pp 153-156 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

A Slodzian's microanalyser with a horizontal target, was used to study the secondary ion emission of solid and liquid aluminium versus temperature from 300 to 1000°K. An increase with tem-

perature of the secondary emission in channelling directions and a decrease in the other directions were observed. The behavior of the clusters was also studied. There was no great difference between solid and liquid state for the clusters intensities. A slight difference is found in the energy distribution of secondary ions when the crystal is bombarded in different directions. (auth)

34475 INFLUENCE OF CHANNELLING ON SECONDARY ION EMISSION YIELDS. Bernheim, M. (Paris Univ., Orsay, France). pp 157-160 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The sputtering yield of a single crystal changes very sharply with the relative orientation of the primary beam and the lattice. This is related to the channelling effect of the primary ion through the lattice. The secondary ion emission yield varies when a monocrystalline target is rotated around an axis normal to the surface and the incidence angle of the primary beam is kept constant at about 60 degrees. The intensities of different types of ions, monoatomic ions of 0 to 15 eV and fast ions 100 eV, 200 eV, 500 eV, multi-charged and polyatomic species, were recorded as a function of the target orientation. Different ways of reducing the variation of penetrations of the primary ion into the target to suppress the differences of sputtering in order to be able to analyse thin polycrystalline target by making use of the secondary ion emission were investigated. (auth)

34476 ENERGY DISTRIBUTION OF SECONDARY IONS FROM 15 POLYCRYSTALLINE TARGETS. Jurela, Z. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 161-166 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

Fifteen metallic and semiconductor polycrystalline targets of 99.9% purity were bombarded with an Ar^+ ion beam of 40 keV energy. The energy distribution of different kinds of secondary ions of basic target material (atomic and molecular, positively and negatively charged), as well as of negative ions (C^-, C_2^-, O^- and O_2^-) formed by sputtering the surface impurities from bombarded targets was measured. The energy distribution of secondary ions was measured in the range of $E_2 > 1$ eV. The upper measurement limit depended on the yield of observed ion species and it reached $E_2 \leq 3000$ eV. The shape of the energy distribution curves could be explained satisfactorily by the law for the non-adiabatic emission process. (7 fig, 31 references) (auth)

34477 DETERMINATION OF THE NEGATIVE ION YIELD OF COPPER SPUTTERED BY CESIUM IONS. Abdullayeva, M. K.; Ayukhanov, A. K.; Shamsiyev, U. B. (Inst. for Electronics, Tashkent). pp 167-171 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

This paper describes the determination of secondary ion yields for negative ions obtained by bombardment of copper by cesium ions. Stable and reproducible surface conditions are reached by high rate sodium deposition simultaneously with sputtering. An optimum thickness of sodium corresponding to about one monolayer is found. Total negative ion yields K_Σ^- are measured by a double modulation technique. Individual negative ion yields K_i^- are then found by mass spectrometrically determining the various negative ion intensities, the sum of which relates linearly to K_Σ^-. This method is based on the assumption of an equal angular and energy distribution of all sputtered negative ions. Data are given for K_Σ^- and $K_{\Sigma_n}^-$ and K_3^-. The dependence of K_i^- on primary ion energy (500 to 2500 eV) is similar to ordinary sputtering which points to the same basic mechanism in both cases. (auth)

34478 OBSERVATION OF CLUSTERS IN A SPUTTERING ION SOURCE. Herzog, R. F. K.; Poschenrieder, W. P.; Satkiewicz, F. G. (GCA Corp., Bedford, MA). pp 173-179 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

This paper reports previously unpublished results which were obtained in 1966. We systematically investigated the dependence of cluster ion intensities on the bombarding gases He^+, Ar^+, and Xe^+ (energies: 4 to 12 keV, current densities: 100 mA/cm^2). Frequently, the observed structures in the relative cluster intensities were quite puzzling, e.g., for Al and Si. Attempts to correlate these structures to crystal configurations failed, nor did any pattern develop from simple valency considerations alone. Initial ion energy distribution measurements from 0 to 1200 eV showed significant differences for atomic ions and cluster ions. This effect is used to reduce interference problems caused by cluster ion peaks in SIMS applied to trace analysis of solids. The results are discussed and compared with those of other investigators, also including cluster formation by vaporization and sparking. Extending known theoretical considerations may possibly afford a general understanding of the intensity structure. The formation and ejection mechanisms of clusters, however, remain unknown. Thermal effects to explain the latter are definitely discounted by the magnitude of the observed initial cluster energy (> 10 eV). Also discussed are two phenomena which demonstrate the presence of the bombarding gas in the surface. (auth)

34479 ANGULAR DEPENDENCE OF CLUSTERS SPUTTERED FROM A TUNGSTEN SINGLE CRYSTAL SURFACE. Staudenmaier, G. (Univ., Munich). pp 181-184 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The anisotropy of positively charged clusters sputtered with 150-keV Ar^+ ions from a tungsten single crystal was investigated with a mass and energy spectrometer. Not only the monomer W^+ but also the clusters W_2^+, W_3^+ and W_4^+ (so far investigated) show maxima of emission along close packed directions. The maximum cluster yield along a ⟨111⟩ direction normalized to the yield along a random direction increases with increasing cluster size and cluster energy, although the absolute cluster yield decreases. An interpretation of the experimental results on the basis of a simple statistical model of cluster formation kinetics is presented which explains the yield profiles of the anisotropic contribution fairly well. (auth)

34480 SECONDARY EMISSION OF MOLECULAR IONS FROM LIGHT-ELEMENT TARGETS. Leleyter, M.; Joyes, P. (Paris Univ., Orsay, France). pp 185-189 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

Experimental results and calculations are presented on ion clusters produced by primary ion bombardment of light element samples (lithium, beryllium, graphite). Alternations according to the parity of the atom number in the clusters are found in their stabilities, ionization potentials, and electron affinities: $Li_{2n\pm1}^+$ and C_{2n}^- ions are found more stable than Li_{2n}^+ and $C_{2n\pm1}^-$ ions respectively. On the other hand, stability of Be_n^+ decreases when n increases. These alternating properties are studied with CNDO computations. Results are compared to those of other authors. (auth)

34481 NEUTRAL BEAM SPUTTERING OF POSITIVE ION CLUSTERS FROM ALKALI HALIDES. Richards, J.; Kelly, J. C. (Univ. of New South Wales, Sydney). pp 191-194 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

Neutral argon atom beams of 15 keV energy were used to sputter alkali halides and the ejected positive ions were analysed in energy, mass, and angular distribution. The use of a neutral beam, rather than an ion beam, minimized surface charge and the deflection of ejected ions by electrostatic interaction with a charged incident beam. A cluster component of the form K_2Cl^+, $K_3Cl_2^+$ and higher members of the series is found for all alkali halides studied. (auth)

34482 DEFLECTION OF SPUTTERED IONS BY SURFACE CHARGES. Richards, J.; Dalglish, R. L.; Kelly, J. C. (Univ. of New South Wales, Sydney). pp 195-197 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The trajectories of ions sputtered from an insulating surface carrying a surface charge were computed. Results show that yields measured in particular directions can be in serious error as the trajectories of low-energy sputtered ions depend critically on surface charge and point of origin of the ion. The distorted yield curves for 1.2-eV ions and 10-eV ions leaving a surface with a ten volt surface potential are calculated. (auth)

34483 SURFACE DAMAGE AND TOPOGRAPHY CHANGES PRODUCED DURING SPUTTERING. Nelson, R. S.; Mazey, D. J. (Atomic Energy Research Establishment, Harwell, Eng.). pp 199-206 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

Ion bombardment of solids creates radiation damage in the form of interstitials and vacancies which agglomerate into dislocation structures, so becoming visible in the electron microscope. Furthermore, ion bombardment causes sputtering of atoms from the surface of solids which can give rise to changes in surface topography. The paper reviews the salient features of these two phenomena and points out their interrelation. (auth)

34484 TOPOGRAPHY OF SPUTTERED SEMICONDUCTORS. Wilson, I. H. (Univ. of Surrey, Guildford, Eng.). pp 217-225 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The surfaces of semiconductor single crystals were observed using a scanning electron microscope after bombardment at normal incidence at room temperature with doses between 0.5×10^{18} and 3×10^{18} of 40-keV argon ions/cm^2. The usual topography of the sputtered surface and the perturbing effects of dirt and contamination are reported, and observations of the variation of topography with dose are reported for GaAs. An explanation for the features observed is discussed with particular reference to current models of cone formation and secondary processes such as flux enhancement at the foot of steep slopes. The behavior of Si, Ge, GaAs, and InP was consistent with an amorphous surface. In the case of CdTe, CdS, and GaP it appeared that the crystal structure was retained resulting in a topography of the sputtered surface that is sensitive to orientation. InSb appears to undergo a chemical change during ion bombardment. (10 fig) (auth)

34485 PHOTON EMISSION FROM LOW-ENERGY ION AND NEUTRAL BOMBARDMENT OF SOLIDS. Tolk, N. H.; Simms. D. L.; Foley, E. B.; White, C. W. (Bell Telephone Labs., Murray Hill, NJ). pp 265-273 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Pulishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

Low-energy heavy particle bombardment of solid surfaces is observed to be accompanied by the emission of infrared, visible, and ultraviolet radiation. Line radiation arising from transitions between discrete atomic or molecular levels may be attributed to the decay of sputtered or backscattered excited particles which have escaped the surface. Broadband continuum radiation which is also observed in low-energy heavy particle collisions with surfaces arises from the surface and appears to be a strictly solid state phenomenon. Measurement of collision-induced optical radiation constitutes a powerful tool for studies of the fundamental outershell electronic processes which result from the interaction of low-energy atomic particles with solids. (auth)

34486 PHOTON-EMISSION INDUCED BY IMPACT OF FAST IONS ON METAL SURFACES. Kerkdijk, C. B.; Thomas, E. W. (FOM-Instituut voor Atoom en Molecuulfysica, Amsterdam). pp 275-278 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

A study was made of photon emission induced by impact of H^+ and He^+ ions on gold and nickel metallic surfaces. An energy-selected ion beam (3 to 10 keV) is directed onto a metal surface and the emitted light is analyzed by a monochromator (3000–6000 Å). The target is located in a vacuum chamber with base pressure of 1×10^{-9} torr, the target is cleaned by heating and by Ar^+-sputtering. Lines from the He-spectrum (3^3D, 4^3D, $5^3D \rightarrow 2^3P$ and $3^3P \rightarrow 2^3S$) and H-spectrum (Balmer α, β, γ) are observed for impact of He^+ and H^+ respectively on both targets. No singlet lines of helium were observed and also no line emissions from the target material. The line shape of the He lines was studied in detail. The shape can be qualitatively explained by Doppler shifts of emission from projectiles scattered by bi-particle collisions in the surface. The total intensity of the lines increases as a function of beam energy and of incidence angle on the surface. (auth)

34487 TIME DECAY OF ION BOMBARDMENT INDUCED PHOTON EMISSION. Martell, J. G.; Olson, N. T. (Massachusetts Inst. of Tech., Cambridge). pp 279-281 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

Spectral line emission from sodium ion bombardment of aluminum polycrystalline targets was observed to be dependent upon the target ion bombardment dose. Al and Na emission levels from an unbombarded target decay with ion dose to a saturation level. Qualitative calculations show that the photon emission decay time is consistent with implanted ion saturation times. Cesium ion bombardment, because of its shorter range and smaller saturation time, did not yield any transient results. (auth)

34488 ANGULAR AND ENERGETIC DISTRIBUTIONS OF SECONDARY ELECTRONS EMITTED BY SOLID TARGETS UNDER IONIC BOMBARDMENT. Colombie, N.; Benazeth, C.; Mischler, J.; Viel, L. (Universite Paul Sabatier, Toulouse). pp 283-287 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The energy distributions of secondary electrons emitted by targets bombarded with ions in the range 10–100 keV, are studied. The energy spectra show an intensive peak at 2 eV. Beyond, in the experiments performed on light elements ($Z \leq 30$) we observe an Auger peak relating to the creation of a hole on the first atomic energy level situated below the valence band (KVV, $L_{23}VV$ and $M_{23}VV$ transitions) accompanied by two or three peaks corresponding to excitation of surface plasmons. Energy spectra obtained from phosphorus and sulphur compounds reveal Auger electrons corresponding to $L_{23}(P)$ VV (or $L_{23}(S)$ VV) and $L_{23}(P)$ $M_{IV\text{-}V}(Ga)$ V (or $L_{23}(P)$ $N_{IV\text{-}V}(In)$ V) transitions; moreover peaks due to plasmon excitations and d band excitations can be distinguished. The first results obtained from some alloys show Auger spectra, characteristic of the different elements which compose the alloy. An anisotropy in the energy angular distribution of secondary electrons emitted from copper single crystal is observed. (auth)

34489 ESTIMATION OF ELECTRON POTENTIAL EMISSION YIELD DEPENDENCE ON METAL AND ION PARAMETERS. Kishinevskii, L. M. (Inst. for Electronics, Tashkent). pp 289-293 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The paper discusses the dependence of γ, the coefficient of potential emission of electrons from metals, on the work function φ and Fermi energy ϵ_F for metals and the ionization energy of ions E_i. It was found that $\gamma \approx 0.2/\epsilon_F\,(0.8\,E_i - 2\varphi)$ in the range $3\varphi < E_i < 2(\epsilon_F + \varphi)$. Deviations from this dependence exceeding 10% have been observed at $E_i < 3\varphi$ and at $E_i > 2(\epsilon_F + \varphi)$. Theoretical estimates are in satisfactory agreement with experimental results. (auth)

34490 DEPENDENCE OF INELASTIC ENERGY LOSS ON THE ATOMIC NUMBERS OF THE IONS. Baklitskii, B. E.; Parilis, E. S.; Ferleger, V. K. (Inst. for Electronics, Tashkent). pp 295-300 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The present paper provides a general analytical expression for inelastic losses taking into account the shell effects and also

tracing the Z-oscillation of kinetic ion-electron emission from the surface. (auth)

34491 ENERGY SPECTRUM OF ELECTRONS EMITTED BY ALKALI HALIDE CRYSTALS UNDER IMPACT OF ION AND ATOM BOMBARDMENT. Urifov, U. A.; Gaipov, S.; Rakhimov, R. R. (Inst. for Electronics, Tashkent). pp 301-304 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The energy distribution of electrons emitted by crystals of KBr, NaCl, and LiF under bombardment by Kr^+ and Kr^0, Ar^+ and Ar^0, He^+ and He^0 in the energy range of 100–6000 eV was studied by the method of analysis in the field of a 127° cylindrical condenser. The separation of electron and ion components from the general spectrum of secondary particles was carried out by a weak magnetic field directed at right angle to the electrical field of the condenser. A comparison of the electron spectrum for ions and atoms illustrates the behavior of electron spectra of potential and kinetic emission. The energy spectra of electrons of kinetic electron emission are explained on the basis of the mechanism of the Auger phenomenon. (auth)

34492 ION SOURCE OF HYDROGEN IONS AT LOW GAS PRESSURES. Starodubtsev, S. V.; Muminov, V. A.; Babal'yants, V. F.; Abdurakhmanov, A. Kh. pp 233-234 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

An ion source is described with radial extraction of the hydrogen ions. The source is placed in a vacuum chamber having a volume of 600 liters which is evacuated by a diffusion pump at a rate 2500 l/sec at a pressure of 10^{-5} mm Hg std. The working gas pressure was 2 to 4×10^{-4} mm Hg std. The ion current attained a value of 50 mA and higher. (SJR)

34493 CORRELATION COEFFICIENTS FOR HIGHER ORDER DIFFERENCES IN MULTIPLE SCATTERING. Rao, Y. V. (Dublin Inst. for Advanced Studies). Acta Phys. Acad. Sci. Hung.; 37: No. 1-2, 13-16(1974). (In Russian).

The correlation coefficients for the higher order differences in multiple scattering are shown to be higher than those given in the framework of Moliere's theory. The trend of the increased values of the correlation coefficient is found to be consistent with the calculations of Dado and Rosendorff. It is pointed out that the values for correlation coefficients are based on Moliere's theory, which makes allowance for the finite size of the nucleus. Finally, it is concluded that the choice of correct form factors together with more refined models should reconcile the theory with the observation. (auth)

34494 TRIPLE BACKSCATTERING (REFLECTION) OF ELECTRONS WHEN USING $^{90}Sr-^{90}Y$, $^{144}Ce-^{144}Pr$, AND $^{106}Ru-^{106}Rh$ BETA SOURCES. Boyarshinov, L. M. At. Energ. (USSR); 35: No. 6, 424-425(Dec 1973). (In Russian).

The dependence of the characteristics of triple reflection of electrons on the maximum energy of the sources was studied in the interval from 0.765 to 3.53 MeV. Intense currents of triply reflected electrons were obtained. The power dependence of the intensity and energy on the atomic number of the sources was determined. The dependence is much sharper than for single reflection. (JSR)

34495 PHOTON EMISSION FROM A BOMBARDED Al TARGET AND ITS DEPENDENCE ON OXYGEN. Kerkdijk, C. B.; Kelly, R. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). Surface Sci.; 47: No. 1, 294-300(Jan 1975).

From 3rd international symposium on surface physics; Utrecht, The Netherlands (26 Jun 1974).

During Ne^+ bombardment of Al, 8 different spectral lines of Al I were observed. The intensities were found to depend on the presence of oxygen, the oxygen being in part adsorbed at the surface and in part recoil-implanted beneath the surface. A model is presented in which the oxygen dependence is related to resonance electron transfer between sputtered Al atoms and the target surface. The same model also accounts for the oxygen dependence of the yields of the secondary ions Al^+, Al^{2+}, and Al^{3+}. (auth)

34496 SECONDARY ION EMISSION FROM SILICON AND SILICON OXIDE. Maul, J.; Wittmaack, K. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg; Muenchen (F. R. Germany). Physikalisch-Technische Abt.). Surface Sci.; 47: No. 1, 358-369(Jan 1975).

From 3rd international symposium on surface physics; Utrecht, The Netherlands (26 Jun 1974).

The emission of Si^+, Si^{2+}, Si^{3+}, Si_2^+, SiO^+ and B^+ from boron doped silicon has been studied at oxygen partial pressures between 2×10^{-10} and 2×10^{-5} torr. Sputtering was done with 2 to 15 keV argon ions at current densities between 3 and 40 $\mu A/cm^2$. The relative importance of the different ionization processes could be deduced from a detailed study of the yield variation at varying bombardment conditions. Comparison with secondary ion emission from silicon dioxide allows a rough determination of the composition of oxygen saturated silicon surfaces. (auth)

34497 THE INFLUENCE OF THE TARGET TEMPERATURE ON MULTIPLE SCATTERING OF LOW ENERGY NOBLE GAS IONS FROM A (100) FACE OF COPPER. Poelsema, B.; Verhey, L. K.; Boers, A. L. (Rijksuniversiteit Groningen (Netherlands)). Surface Sci.; 47: No. 1, 256-257(Jan 1975).

From 3rd international symposium on surface physics; Utrecht, The Netherlands (26 Jun 1974).

Multiple scattering along low index directions (⟨100⟩, ⟨110⟩) on crystal surfaces can be described reasonably well by means of the so-called chain model. For a fixed scattering angle θ this model predicts a double peak energy spectrum within a certain interval of angles of incidence ψ around specular reflection, while outside this interval scattering through θ is forbidden. Recently, it has been shown that thermal vibrations of the chain atoms are largely responsible for the observed discrepancies. The present work deals with further theoretical and experimental investigations on surface vibrational effects. Experiments have been performed with a fixed scattering angle $\theta = 30°$ and an angle of incidence $\psi = 15°$. Energy distributions for 10 keV Ar^+ ions reflected along ⟨100⟩ and ⟨110⟩ rows on a Cu (100) face are measured. The target temperature could be varied in the range 200–800°K. The residual gas pressure in the collision chamber was $\sim 3 \times 10^{-10}$ torr. (auth)

34498 MULTIPLE SCATTERING AND NEUTRALIZATION ASPECTS OF LOW ENERGY NOBLE GAS IONS INCIDENT ON A Cu(110) CRYSTAL. Wit, A. G. J. de; Schootbrugge, G. A. van der; Fluit, J. M. (Rijksuniversiteit Utrecht (Netherlands)). Surface Sci.; 47: No. 1, 258-271(Jan 1975).

From 3rd international symposium on surface physics; Utrecht, The Netherlands (26 Jun 1974).

Experiments have been done with 1 keV Ne^+ ions bombarding a Cu(110) single crystal in a (111) plane. From the measured energy spectra of the scattered ions the minimum and maximum angles for multiple scattering on the surface are determined. These minimum and maximum scattering angles were also calculated using a computer model. The parameters for an interatomic potential function between ion and metal atom are determined by comparison of the experimental and calculated scattering angles. A neutralization model for an energetic ion at an atomic surface is given. The reliability of this model is tested by comparison of the results of computer calculations and the measured peak intensity distributions as a function of the scattering angle. (auth)

34499 INELASTIC COLLISIONS OF ARGON AND CHLORINE IONS IN CARBON. Turkenburg, W. C.; Colenbrander, B. G.; Kersten, H. H.; Saris, F. W. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). Surface Sci.; 47: No. 1, 272-281(Jan 1975).

From 3rd international symposium on surface physics; Utrecht, The Netherlands (26 Jun 1974).

Inelastic effects have been studied under multiple scattering conditions in ion-solid interactions. Charge state distributions of argon and chlorine ions emerging from carbon foils were measured in the energy range from 70 to 350 keV. Differences in the average equilibrium charge state of argon and chlorine at fixed velocities are observed which is explained by inner-shell vacancy production and surface neutralization. The relevance of the obtained results for surface studies with ion beams under multiple scattering conditions is discussed. (auth)

34500 ENERGY SPECTRA OF 6-32 keV NEUTRAL AND IONIZED Ar AND He SCATTERED FROM Au TARGETS; IONIZED FRACTIONS AS FUNCTIONS OF ENERGY. Buck, T. M.; Chen, Y. -S.; Wheatley, G. H. (Bell Telephone Labs., Inc., Murray Hill, N. J. (USA)); van der Weg, W. F. (N. V. Philips Research Laboratories, Dept. Amsterdam, The Netherlands). Surface Sci.; 47: No. 1, 244-255(Jan 1975).

From 3rd international symposium on surface physics; Utrecht, The Netherlands (26 Jun 1974).

The neutralization of ions is an important aspect of low energy ion scattering for surface analysis. Electrostatic energy analyzers (ESA) have been used almost exclusively in such work, and information on charge neutralization efficiencies is needed for quantitative interpretation of ESA data. In the past, the occurrence in low energy ion spectra of surface peaks and low backgrounds due to scattering from inside the solid has been attributed to preferential neutralization of ions which penetrate beyond the surface. In the work described, a time-of-flight technique was used to measure energy spectra of both neutral and ionized Ar and He scattered at 90° from a polycrystalline gold target. Incident energies of 6-32 keV were used. The energy spectra of neutral Ar scattered from polycrystalline gold exhibit sharp surface peaks, and double scattering shoulders, over this entire energy range. For He there is a gradual downward slope toward lower energy rather than a sharp surface peak. The behavior in both cases is attributed to large scattering cross-sections which cause a loss of beam particles during penetration. A calculation using a $1/r^2$ potential illustrates this effect as a function of energy for helium. In the present experiments it is found that the ion fraction of scattered argon does indeed depend on depth of penetration. This is in contrast to the behavior of He and H at higher energies, e.g., 100 keV, in which cases the charge state depends on emergent velocity but not on depth of penetration. The characteristic shapes of ion scattering spectra in this energy range appear to result from both neutralization and beam attenuation inside the target. (auth)

34501 PHASE OF REFLECTION OF VERY LOW ENERGY ELECTRONS AT CRYSTAL SURFACES. McRae, E. G. (Bell Telephone Labs., Inc., Murray Hill, N. J. (USA)). Surface Sci.; 47: No. 1, 167-180(Jan 1975).

From 3rd international symposium on surface physics; Utrecht, The Netherlands (26 Jun 1974).

The amplitude coefficients of electron reflection at crystal surfaces are complex numbers, each of which may be characterized by a reflection intensity (the squared modulus of the coefficient) and a phase. The phase of reflection of very low energy ($\lesssim$10 eV) electron reflection is described on the basis of existing theory, and experimental approaches to phase determination are reviewed. Theoretical properties of the phase are described on the basis of the two-beam dynamical theory of diffraction. The model considered is an idealized substrate crystal with an attached selvedge (surface region). The indirect effect of inelastic scattering (absorption) is included by going to complex values of the electron energy or of the surface-normal component K of the propagation vector. In the absence of a selvedge the phase is determined solely by the band structure of the substrate crystal. If a selvedge is present there are large additional effects on the phase associated with zeros of the amplitude coefficient of reflection on the complex K plane. The experimental approaches considered are: (1) measurement of the kinetic energy distributions of ions produced in the field ion microscope, and (2) measurement of the periodic deviations from the Schottky line in field-assisted thermionic emission and photo-emission. Recent results of phase determination for W(011) surface by method (1) are summarized and compared with theoretical expectations. (auth)

34502 SURFACE INVESTIGATION BY ION SCATTERING AND SECONDARY ION MASS SPECTROSCOPY. Heiland, W. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Electron. Fis. Apl.; 17: No. 1-2, 151-157(1974).

Secondary ion mass spectroscopy (SIMS) and ion scattering spectrometry (ISS) are parts of the general phenomena occuring during the interaction of ion beams with solids. Since SIMS yields the information about the surface by an analysis of secondary ions released by a sputtering process, sputtering and the ion formation at solid surfaces are the physics governing this technique. The ion formation problem might be overcome by suitable ionization technique independent of the state of the surface. ISS gains the information about surface composition from the energy of the backscattered primary ions. Qualitatively the scattering process is well understood, but for a quantitative analysis better cross section data may be needed. A further problem is the neutralization process of low energy rare gas ions at solid surfaces generally used for ISS. The merits of SIMS are extreme sensitivity for some species, e.g., alkali, information about molecules on surfaces, detection of hydrogen and hydrocarbons. ISS claims absolute surface sensitivity, e.g., only the outermost layer of a surface is analyzed, the possibility of the analysis of surface topography and a good chance for quantitative surface composition analysis in the case of clean surfaces. (auth)

34503 RAREFIED GAS DYNAMICS. Eighth International Symposium, Stanford, California, July 10-14, 1972. Karamcheti, K. (ed.). New York; Academic Press, Inc. (1974). 559p. (CONF-720740-). $22.50.

The conference contained 50 papers. Separate abstracts were prepared for 10 papers. Other papers were outside the scope of NSA. (JFP)

For abstracts of individual papers see: 34292, 34371, 34504-34510, and 34568.

34504 FREE JET TEMPERATURE EXTRACTION FROM MOLECULAR BEAM PROFILES. Bossel, U. (DFVLR Institut fuer Dynamik verduennter Gas, Goettingen, Ger.); David, R.; Faubel, M.; Winkelmann, K. pp 235-242 of Rarefied Gas Dynamics. Karamcheti, K. (ed.). New York; Academic Press, Inc. (1974).

From 8th international symposium on rarefied gas dynamics; Stanford, California, USA (Jul 1972). See CONF-720740-.

Observed nozzle beam intensity profiles are compared to an analysis which accounts for the effects of stream line divergence, temperature anisotropy and system configuration. The agreement between this analysis and experimental evidence appears to verify the pertinent assumptions and to indicate how information on the freezing of perpendicular and rotational free jet temperatures can be extracted from observed beam intensity profiles. (auth)

34505 MOLECULAR-BEAM SAMPLING OF CONTINUUM GAS MIXTURES. Young, W. S.; Wang, Y. G.; Sharma, P. K.; Rodgers, W. E.; Knuth, E. L. (Univ. of California, Los Angeles). pp 253-260 of Rarefied Gas Dynamics. Karamcheti, K. (ed.). New York; Academic Press, Inc. (1974).

From 8th international symposium on rarefied gas dynamics; Stanford, California, USA (Jul 1972). See CONF-720740-.

Gas composition measured by the mass spectrometer in a molecular-beam sampling system is compared with gas composition in the beam source. Criteria for either avoiding or minimizing distortion of composition during the sampling process are reported. Correlations of unavoidable distortions with dimensionless parameters are suggested. (auth)

34506 MASS SEPARATION IN CLUSTER BEAMS BY CROSSED FREE JETS. Gspann, J.; Vollmar, H. (Univ., Karlsruhe, Ger.). pp 261-267 of Rarefied Gas Dynamics. Karamcheti, K. (ed.). New York; Academic Press, Inc. (1974).

From 8th international symposium on rarefied gas dynamics; Stanford, California, USA (Jul 1972). See CONF-720740-.

Mass dependent deflection of the clusters of a condensed molecular beam of nitrogen results from intersection with a free jet of carbon dioxide. This mass separation combined with time-of-flight mass spectrometry allows the determination of the size distribution of the clusters which are found to have a most probable size of about 10^4 molecules per cluster. Assuming the clusters to be spherical particles of solid nitrogen, drag coefficients of clusters in free molecular flow of about 3 are observed which increase with decreasing cluster size. (auth)

34507 ACCURATE MEASUREMENT OF THE SPEED DISTRIBUTION FUNCTION OF A MOLECULAR JET REFLECTED ON A SURFACE. Berthier, J. P.; Constans, A.; Daury, G.; Lostis, P. (Surface Physics Lab., Paris). pp 269-278 of Rarefied Gas Dynamics. Karamcheti, K. (ed.). New York; Academic Press, Inc. (1974).

From 8th international symposium on rarefied gas dynamics; Stanford, California, USA (Jul 1972). See CONF-720740-.

An original method is presented for the distribution function measurement; the measurement of this function is made from an integral quantity and allows one to get accurate results from a noisy environment quantity. Then one proceeds to the probability density function through numerical deconvolution. An example is given, corresponding to the argon and molybdenum surface interaction case. (auth)

34508 NUCLEATION EXPERIMENTS IN MOLECULAR BEAMS. Armstrong, J. A.; Stein, G. D. (Northwestern Univ., Evanston, IL). pp 279-286 of Rarefied Gas Dynamics. Karamcheti, K. (ed.). New York; Academic Press, Inc. (1974).

From 8th international symposium on rarefied gas dynamics; Stanford, California, USA (Jul 1972). See CONF-720740-.

A nozzle molecular beam is used as a cluster generator, and the beams are examined with an ionization gage detector and high energy electron diffraction. The diffraction patterns of carbon dioxide and water for conditions of maximum clustering have "averaged" cluster sizes of 1400 and 3400 molecules/cluster, and crystalline structure of simple cubic and diamond

cubic which is characteristic of their respective bulk phases. (auth)

34509 NONREACTIVE SCATTERING OF MOLECULAR BEAMS FROM SOLID SURFACES: A REVIEW. Smith, J. N. Jr. (Gulf Radiation Tech., San Diego, CA). pp 345-360 of Rarefied Gas Dynamics. Karamcheti, K. (ed.). New York; Academic Press, Inc. (1974).

From 8th international symposium on rarefied gas dynamics; Stanford, California, USA (Jul 1972). See CONF-720740-.

This review covers experimental studies of gas-surface scattering reported in the period from approximately 1969 through the first half of 1972. It is confined to rare gas scattering from a variety of metal single crystals at incident energies from about 0.025 eV to nearly 20 eV and includes a discussion of the various scattering "regimes" in that energy range. Apart from parametric correlations, no attempt is made to assess the validity of the various theoretical models. (auth)

34510 HELIUM COOLED MASS SPECTROMETER ION SOURCE FOR UPPER ATMOSPHERE RESEARCH. Offermann, D. (Univ., Bonn). pp 535-541 of Rarefied Gas Dynamics. Karamcheti, K. (ed.). New York; Academic Press, Inc. (1974).

From 8th international symposium on rarefied gas dynamics; Stanford, California, USA (Jul 1972). See CONF-720740-.

Two types of helium cooled mass spectrometer ion sources were developed for measurements in the middle and lower parts of the thermosphere. Some results of wind tunnel tests and rocket flights are presented. (auth)

34511 CAVITY CURRENT ENHANCEMENT BY DIELECTRICS. Little, R. G.; Lowell, R.; Uglum, J. R. (Simulation Physics, Inc., Burlington, MA). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 249-252 (Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

The results of an experimental program are presented which demonstrate that dielectric surfaces can significantly enhance the transport of current through evacuated cavities. The gas pressures involved are well below those necessary for space charge neutralization. (auth)

Atomic and Molecular Properties

Refer also to abstract 34569.

34512 (AD/A-001237) X-RAY FLUORESCENCE YIELDS AND PHOTOELECTRIC CROSS SECTIONS AND ATOMIC INNER-SHELL TRANSITIONS. Final Report, 1 November 1971 – 31 October 1974. Crasemann, B. (Oregon Univ., Eugene (USA). Dept. of Physics). 31 Oct 1974. 12p. NTIS $3.25.

The final report briefly summarizes research on contracts entitled "x-ray fluorescence yields and photoelectric cross sections," and "atomic inner-shell transitions." (auth)

34513 (STI/RUB-356) ATOMS, MOLECULES, AND LASERS. Lectures Presented at the International Winter College, Trieste, Italy, January 17 to April 10, 1973. (International Atomic Energy Agency, Vienna (Austria)). Dec 1974. 717p. IAEA $38.00.

Separate abstracts were prepared for fifteen of the eighteen papers presented. (WMD)

For abstracts of individual papers see: 32864, 32865, 34283, 34521, 34557–34561, and 34570–34575.

34514 MODIFIED ADIABATIC APPROXIMATION FOR ISOELECTRONIC SEQUENCE OF HELIUM WITH THE SEPARATION OF VARIABLES IN ELLIPTICAL COORDINATES. Smirnov, E. P.; Rebane, T. K. Opt. Spectrosc. (USSR) (Engl. Transl.); 37: No. 4, 451-452(Oct 1974).

Translated from Opt. Spektrosk.; 37: No. 4, 791-793(Oct 1974).

A more accurate calculation of the energy levels of atoms of the isoelectronic sequence of helium in the modified adiabatic approximation framework is carried out based on an accurate numerical solution of the equation for a fast electron that allows a separation of variables in elliptical coordinates. The energy levels are listed for helium, lithium ions, and beryllium ions. (JFP)

34515 KINETICS OF FILLING OF HELIUM LEVELS EXCITED BY AN ELECTRON BEAM. Bogdanova, I. P.; Erish, S. E.; Yakovleva, V. I. Opt. Spectrosc. (USSR) (Engl. Transl.); 37: No. 4, 462-464(Oct 1974).

Translated from Opt. Spektrosk.; 37: No. 4, 807-809(Oct 1974).

The kinetics of populating the helium levels as it depended on the pressure of the gas was traced at a helium pressure of $2.4(10)^{-3}$Torr using the method of delayed coincidences. (JFP)

34516 ULTRAVIOLET EMISSION SPECTRA OF OH^+ AND OD^+. Rotational Structure and Perturbations in the $A^3\Pi_i - X^3\Sigma^-$ TRANSITION. Merer, A. J. (Univ. of British Columbia, Vancouver); Malm, D. N.; Martin, R. W.; Horani, M.; Rotas, J. Can. J. Phys.; 53: No. 3, 251-283(1 Feb 1975).

The $A^3\Pi_i - X^3\Sigma^-$ emission systems of OH^+ and OD^+ were reinvestigated in detail. Fourteen bands were analyzed (of which seven are new), and accurate rotational constants were obtained for the levels v = 0 to 2 in the two states of OH^+ and v = 0 to 3 in the two states of OD^+. Corrected assignments are given for the low J lines in the bands of OH^+ (which are important in astrophysical spectra, such as those of H_2O containing comets). The perturbations in the $A^3\Pi$ states of both isotopes were studied quantitatively, and the erratic Λ doubling explained in detail. The position of the perturbing $b^1\Sigma^+$ state was determined to within a few cm^{-1}, and minor perturbations by the $A^1\Delta$ state were characterized. Values of the spin-orbit coupling constant, A, and the spin–spin interaction parameter, α, were extracted from the data of $OD^+A^3\Pi$ v = 0. (auth)

34517 TRANSITION OF $A^2\Sigma^+ \rightarrow X^2\Pi$ OF THE MOLECULES $P^{16}O$ AND $P^{18}O$. Perturbations of the $A^2\Sigma^+$ State. Coquart, B.; Da Paz, M.; Prudhomme, J. C. (CNRS, Reims Cedex, France). Can. J. Phys.; 53: No. 4, 377-384(15 Feb 1975). (In French).

New emission bands of the system $A^2\Sigma^+ \rightarrow X^2\pi$ of the molecule $P^{16}O$ were analyzed, and this transition for $P^{18}O$ was studied for the first time under an average dispersion of 0.30 Å/mm. The levels 0, 1, 2, 3, 4, 5, and 6 of the state $A^2\Sigma^+$ of $P^{16}O$ and the levels 0, 1, 2, 3, and 4 of $P^{18}O$ showed local perturbations of varied kinds of which certain previous studies for $P^{16}O$ are attributable to a state $^4\Sigma^-$ and a state $C^2\Sigma^-$. A vibrational quantization of the state $^4\Sigma^-$ is attempted. (JFP)

34518 A MULTICONFIGURATION RELATIVISTIC DIRAC–FOCK PROGRAM. Desclaux, J. P. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Comput. Phys. Commun.; 9: No. 1, 31-45(Jan 1975).

The relativistic Dirac–Fock equations, for neutral atoms or ions in a bound state, are solved numerically within the multiconfiguration approximation. The two, first-order coupled Dirac equations are solved by a five-point, numerical, corrector-predictor method. The "in-out" method described by Hartree is used. Self consistency is obtained by an iterative process. All the one-electron functions are required to be orthogonal. (auth)

34519 POLARIZATION OF $^4He(2^3S_1)$ BY OPTICALLY PUMPED Rb. Keiser, G. M.; Robinson, H. G. (Duke Univ., Durham, N. C. (USA)); Johnson, C. E. (North Carolina State Univ., Raleigh (USA)). Phys. Lett., A; 51: No. 1, 5-6(27 Jan 1975).

The Zeeman resonance in $He(2^3S_1)$ has been observed with narrow linewidth, ~350 Hz, using a technique involving spin-dependent Penning collisions with optically pumped Rb. This linewidth is 100 times narrower than previously reported in determination of g_j (^4He, 2^3S_1). (auth)

34520 EXISTENCE OF He^- IONS IN A DUOPLASMATRON DISCHARGE. Muller, C.; Lorentz, B.; Remy, M. (Nancy-1 Univ., 54 (France). Lab. de Physique des Milieux Ionises). Phys. Lett., A; 51: No. 1, 17-18(27 Jan 1975).

The presence is pointed out of He^- ions in a duoplasmatron discharge and currents of 10^{-15} A are detected. The influence of different parameters on this current is indicated and possible processes for the formation of He^- ions are investigated. (auth)

34521 PHOTOIONIZATION. Gavrila, M. (Univ. of Bucharest). pp 679-701 of Atoms, Molecules, and Lasers. Vienna; International Atomic Energy Agency (1974).

See STI/PUB-356.

A discussion is presented on: (1) general low energy formulas; (2) hydrogen-like atoms; (3) two-electron atoms (helium and positive ions, H^- ions). (auth)

34522 REDUCED COULOMB GREEN'S FUNCTION PROJECTED ON ANGULAR MOMENTUM EIGENSTATE. Suffczynski, M.; Swierkowski, L. (Inst. of Physics, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 22: No. 12, 1273-1275(1974).

The reduced Coulomb Green's functions projected on the definite angular momentum eigenstate have a simple form useful for an analytical evaluation of the second-order perturbation on the hydrogenic energy levels. (auth)

34523 DETERMINATION OF LIFETIMES OF EXCITED STATES OF Ne I, Ne II, Ar I, Ar II, AND Hg I BY MEANS OF PHASE-SHIFT METHOD AND THE DECREASE OF INTENSITY. Osherovich, A. L.; Ivanov, V. N.; Gorshkov, V. N. Vestn.

Leningrad. Univ., Fiz., Khim.; 22: No. 4, 7-11(Nov 1974). (In Russian).

The electron-excitation phase-shift method and the decrease of intensity registration technique were applied to the determination of radiative lifetimes of NeI, NeII, ArI, ArII and HgI transitions. The levels 7^1S_0, 8^1S_0 and 9^1S_0 HgI are also measured by the multichannel delayed coincidence method. There is an agreement (within the limits of accuracy of measurements) between the results of these two methods. (auth)

34524 SURVEY ON EXCHANGE POTENTIALS IN ATOMS AND SOLIDS. Rennert, P. (Martin-Luther Univ., Halle, Ger.). Acta Phys. Acad. Sci. Hung.; 37: No. 3, 219-252(1974).

In this survey on exchange potentials the first principle methods used to define an exchange potential are first described. Then the approximations leading to practicable exchange potentials useful for actual calculations are considered. The different versions of the X_α-method are discussed in detail. Finally the quality of the different exchange potentials is illustrated by examples from atomic and solid state physics. This may be used as a guide in choosing a special exchange potential in a special property calculation. (auth)

34525 LONG- AND INTERMEDIATE-RANGE INTERACTION BETWEEN HYDROGEN ATOMS IN THE $B\,^1\Sigma_u^+$ STATE. Kolos, W. (Univ. of Florida, Gainesville). Int. J. Quant. Chem.; 9: No. 1, 133-142(Jan 1975).

The energy of the hydrogen molecule in the $B^1\Sigma_u^+$ state, for internuclear separations $12 \leq R \leq 20$ a.u., was computed using an 80-term variational wave function depending explicitly on the interelectronic distance. The same type of wave function was employed in the perturbation theory approach. Using the polarization approximation, and not expanding the interaction Hamiltonian, the first-, second- and third-order energies were computed and higher order corrections were estimated. The results show that in the region under consideration $E_{pol}^{(1)}$ and $E_{exch}^{(2)}$ represent the dominant contributions to the interaction energy in the B state. (auth)

34526 VARIATIONAL APPROACH TO THE TWO-BODY DENSITY MATRIX. Garrod, C. (Univ. of California, Davis); Mihailovic, M. V.; Rosina, M. J. Math. Phys. (N. Y.); 16: No. 4, 868-874(Apr 1975).

A variational method for the two-body density matrix is developed for practical calculations of the properties of many-fermion systems with two-body interactions. In this method the energy $E = \Sigma H_{ijkl}\rho_{ijkl}$ is minimized using the two-body density matrix elements $\rho_{ijkl} = \langle\psi|(a_i^\dagger a_j^\dagger a_l a_k)|\psi\rangle$ as variational parameters. The approximation consists in satisfying only a subset of necessary conditions — the nonnegativity of the following matrices: the two-body density matrix, the "two-hole matrix" $Q_{ijkl} = \langle\psi|a_i a_k a_l^\dagger a_j^\dagger|\psi\rangle$ and the particle-hole matrix $G_{ijkl} = \langle\psi|(a_i^\dagger a_j - \rho_{ij})^\dagger (a_k^\dagger a_l - \rho_{kl})|\psi\rangle$. The idea of the method was introduced earlier; some further physical interpretation is given and a numerical procedure for calculations within a small single-particle model space is described. The method is illustrated on the ground state of Be atom using 1s, 2s, 2p orbitals. (auth)

34527 STUDIES OF COLLISIONAL EXCITATION TRANSFER PROCESSES IN HELIUM. Wine, P. H. Tallahassee; Florida State Univ. (1974). 197p. University Microfilms Order No. 75-8061.

Thesis (Ph. D.).

Electron impact excitation was employed in the study of the pressure variation of the steady state luminescence from 27 levels of helium. Apparent cross sections were determined for these levels over the pressure range .025 to .91 torr, a much broader pressure range for observing collisional excitation transfer processes than was previously investigated. A series of model calculations were performed in which experimental data were fit to a set of steady state equations which take into account the various mechanisms by which an excited state can be populated and depopulated. Examination of two levels not directly involved in collisional excitation transfer processes has made it possible to distinguish the effects of collisional excitation transfer from those of secondary electron excitation. (Diss. Abstr. Int., B)

34528 INFLUENCE OF PRESSURE ON THE RADIATION OF THE ATOMIC HELIUM LINES IN THE EXCITATION OF ELECTRON BEAM. Yakovleva, V. I. Vestn. Leningrad. Univ., Fiz., Khim.; 16: No. 3, 132-133(Aug 1974). (In Russian).

Systematic investigation of the population of n^3D levels in helium (n = 3, 4, 5) was conducted at 2 to 130 mtor pressure. An experiment was carried out in the electron gun, the influence of impurities was negligible because the electron gun was separated from the vacuum system by the metal valve and the gas under investigation passed through the heated quartz tube. The experimental results are compared with theoretical calculations. (auth)

34529 PROTON VOLUME EFFECT OF OPTICAL THALLIUM ISOTOPE SHIFT. Chen, S. S. Davis, CA; Univ. of California (1974). 81p. University Microfilms Order No. 75-8322.

Thesis (Ph. D.).

Optical isotope shifts due to the changes in nuclear radius are calculated for isotopes of thallium. A density independent Gaussian potential was used as the neutron-proton interaction. The calculations are based on a particle and pair creation annihilation formalism using both perturbation theory and complete diagonalization to obtain the amplitudes of multipole excitation of the proton core. Results are compared with experimental isotope shifts. (Diss. Abstr. Int., B)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 32509 and 34131.

34530 POSITRON TRAPPING MEASUREMENTS OF HIGH PRECISION USING A LABELLING TECHNIQUE. McKenzie, I. K.; Lichtenberger, P. C. (Guelph Univ., Ontario (Canada). Dept. of Physics). Appl. Phys.; 3: No. 5, 393-396(May 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973).

The small effects associated with positron trapping in metal defects are masked in practice not only by inherent statistical fluctuations, but also by electronic instabilities. The unique directional correlation of annihilation quanta allows us to use a very efficient labelling technique which facilitates simultaneous measurements of the annihilation energy spectrum in the sample and in a standard. The result is that the system becomes essentially free of drift, so that precision of energy determination is limited by the statistics of counting alone. We have used the efficient technique of Ge(Li) spectroscopy together with labelling to measure the annihilation lineshape. Lineshape parameters, including the first two moments, have been extracted from this data. The techniques are applied to the measurement of recovery at room temperature and to a determination of the binding energy of positrons to traps in aluminum. (auth)

34531 THE ROLE OF BOUND STATES IN POSITRONIUM ANNIHILATION. Goldanskii, V. I.; Shantarovich, V. P. (AN SSSR, Moscow, Inst. Khimicheskoj Fiziki). Appl. Phys.; 3: No. 5, 335-351(May 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973). 9 figs.; 7 tabs.; 57 refs.

The temperature dependence of the rates of positronium reactions with diamagnetic organic molecules in liquids, and the observed complicated conversive-chemical interaction of positronium with many paramagnetic molecules in the liquid and gas phases lead to the formulation of some general concepts about positronium interaction with quenchers. The positronium and acceptor (Ps–M) complexing is a very essential step of the interaction mechanism. In the case of unstable complexes the contribution of annihilation from the bound state can change depending on the physical conditions of the reaction (pressure in the gas phase, transition from the gas to the liquid phase, heating or replacement of the liquid solvent). The dependence on temperature and on the solvent nature is accounted for by formation of a "bubble" around the positronium in many liquids. At the moment of complexing the "bubble" shrinks with a swiftness depending upon properties of the liquid (surface tension and viscosity). With unstable complexes this leads to complex decomposition and, correspondingly, either to elimination of interaction with the diamagnetic acceptor or, in the case of paramagnetic acceptors, to conversion on the latter, rather than to annihilation from the bound state. With stable complexes further positronium annihilation will occur only from the bound state. (auth)

34532 POSITRON IMPACT INNER SHELL IONIZATION. Seif el Nasr, S. A. H.; Berenyi, D.; Bibok, G. (Magyar Tudomanyos Akademia, Budapest. Nucleara Kutato Intezet). Z. Phys.; 271: No. 3, 207-210(Dec 1974).

The positron impact ionization cross section for the K-shell was determined in the case of Ni, Y, and Ag at 670 and 490 keV as well as for the L-shell in the case of Yb, Ta, Au, and Pb at 490 keV using a beta-ray spectrometer as a source of monoenergetic electrons and an X-e^+ coincidence arrangement. The results for the K-shell are compared with the theoretical calculations according to Kolbenstvedt and with the earlier experimental values. (auth)

34533 POSITRON DISTRIBUTION IN METALS. Kubica, P.; Stewart, A. T.; Stott, M. J. (Queen's Univ., Kingston, Ontario (Canada)). Appl. Phys.; 3: No. 5, 417-419(May 1974).

From 3rd international conference on positron annihilation; Otaniemi, Finland (7 Aug 1973). (2 figs.; 4 refs.)

A positron wave function incorporating the proper crystal symmetry is calculated for Al using the positron pseudopotential method. The positron ground state energy was also calculated and it was found to be in good agreement with the previous Wigner-Seitz calculations. The pseudopotential matrix elements are shown to be small and thus very accurate calculations can be performed using low order perturbation theory. (auth)

34534 POSITRON ESCAPE FROM ANNIHILATION CENTERS IN ELECTRON-IRRADIATED Si CRYSTALS. Brandt, W.; Cheng, L. J. (New York Univ., N. Y. (USA). Dept. of Physics). Phys. Lett., A; 50: No. 6, 439-440(13 Jan 1975).

The mean positron lifetime in irradiated Si diminishes with increasing temperature between 77°K and 300°K. Isochronal high-temperature crystal anneals reduce the effect. Analysis suggests that thermally activated positrons escape after trapping in radiation-induced defects. (auth)

34535 ELASTIC SCATTERING WITH ALLOWANCE FOR A CLOSED CHANNEL: THE $d\mu$ + p, $p\mu$ + p, $d\mu$ + d, AND $t\mu$ + t PROCESSES. Matveenko, A. V.; Ponomarev, L. I.; Faifman, M. P. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 68: No. 2, 437-446(Feb 1975). (In Russian).

A technique for calculating the elastic scattering cross sections with account of a closed channel is developed in the two-level approximation of the perturbed stationary state method. Scattering cross sections for $p\mu$, $d\mu$ and $t\mu$ meso-atoms in the lower state of the hyperfine structure are found. Resonance effects are found in the cross sections for the $d\mu$ + p and $p\mu$ + p processes. (auth)

34536 POSSIBLE ROLE OF DRY ELECTRONS IN THE FORMATION OF POSITRONIUM IN A LIQUID. Byakov, V. M.; Gol'danskii, V. I.; Shantarovich, V. P. (Inst. of Theoretical and Experimental Physics, Moscow). Dokl. Akad. Nauk SSSR; 219: No. 3, 633-635(21 Nov 1974). (In Russian).

One of the facts unexplained by current models of positronium formation is that the same material dissolved in the matrix can, as a function of conditions, act as a quencher of positronium or as an inhibitor of its formation or as both a quencher and inhibitor simultaneously. Nitrobenzene is such a substance. In the present study it is shown that the inversion of the properties of nitrobenzene results from concepts on the formation of positronium as a result of the recombination of a positron with nonsolvated (super)thermal electrons. (JSR)

34537 RADIATIVE COLLISIONAL QUENCHING OF THE METASTABLE MUONIC-HELIUM ION $\mu He^+(2S)$. Carboni, G. (CERN, Geneva); Pitzurra, O. Nuovo Cim.; 25B: No. 1, 367-389(11 Jan 1975).

A complete quantum-mechanical treatment of the collisional quenching of the metastable $\mu He^+(2S)$ ion is presented. The calculations, based on the distorted-wave approximation, demonstrate that the most important effect leading to destruction of the metastable ion is the formation of a bound molecule $[\mu He^+(2P)He]$; once this molecule is formed, the muon undergoes an electromagnetic transition to the ground state in a very short time ($\sim 5 \cdot 10^{-13}$ s). The results of the calculation are strongly dependent upon the form of the short-range interaction between the muonic ion and the He atoms, suggesting that precision measurements of the lifetime of the metastable 2S-level in muonic helium could yield useful information about the form of this interaction. The quenching rates predicted on the basis of the present theory are found to be larger than the experimentally observed ones; however, as many-body effects could be important at the pressures at which the experiments were performed, it is suggested that low pressure experiments would be useful in testing the validity of the theory. (auth)

34538 Z DEPENDENCE OF π^- MESON NUCLEAR CAPTURE BY FIXED HYDROGEN. Kholodov, N. I.; Gol'danskii, V. I. (Inst. of Chemical Physics, Moscow). Dokl. Akad. Nauk SSSR; 217: No. 2, 322-325(1974). (In Russian).

The probability of π^- meson capture by chemically bound hydrogen was calculated for hydrides of the second period and was found to be linearly dependent on Z of the element in compound with the hydrogen. A direct proportionality was also found between the probability of π^- meson capture on one H atom in the compound and the effective electron charge. (JSR)

Collision Phenomena

Refer also to abstract 34535

34539 (AD/A-000061) NEW ATOMIC BEAM STUDIES AT LOW ENERGIES. Final Report. Neynaber, R. H.; Rutherford, J. A.; Vroom, D. A. (Intelcom Rad Tech, San Diego, Calif. (USA)). 20 Aug 1974. Contract DNA001-74-C-0036. 64p. (RT-8100-005; DNA-3384F). NTIS $4.25.

The major effort was directed toward production of stable neutral beams of uranium and thorium, and measurement of charge transfer processes between these atomic species and the atmospheric ions N^+ and O^+. The processes studied can be represented as $O^+ + U$ to $O + U^+$, $N^+ + U$ to $N + U^+$, $O^+ + TH$ to $O + TH^+$, and $N^+ + TH$ to $N + TH^+$. These reactions are of importance because they may act as sinks for U and TH neutral species. Information on the fate of U and TH is of importance in the development of radar and optical systems codes. In the course of the above measurements, cross sections were also obtained for the charge transfer reactions of U and TH with CO_2^+ and N_2^+. A secondary effort was the measurement of charge transfer cross sections for ground and excited state O^+ ions in collision with O_2 and NO. (auth)

34540 (AD/A-000932) THEORETICAL STUDY OF ATOMIC AND MOLECULAR PROCESSES. Final Report, 11 December 1972-31 March 1974. Constantinides, E.; Dalgarno, A.; Victor, G. A.; Laughlin, C. (GCA Corp., Bedford, Mass. (USA). GCA Technology Div.). Aug 1974. 73p. NTIS $4.25.

Empirical spectral data were employed for the corresponding one-valence-electron ions (N V and O VI) to construct the two-valence-electron ionic systems (N IV and O V). The eigenfunctions constructed for these systems are used to calculate multiplet splittings and intercombination line strengths. A brief theoretical account of the theoretical procedures involved in those calculations is presented. The procedures were tested by carrying out calculations on Be I and Mg I. The results of these calculations and comparisons with available experimental and theoretical data are presented. Values of the internuclear potential for aluminum oxide were calculated. (auth)

34541 (JAERI-M-5567, pp 95-98) IONIZATION YIELD PRODUCED IN GASES BY HEAVY IONS. Classical Mechanical Understanding of Radiation Action on Matter, 2. Ohno, S. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Ab initio calculation of the ionization yield produced in He by 1- or 0.1-MeV Ar^+ and protons was done on the basis of the classical collision theory developed by Thomas in 1927. The ionization yield due to the direct action of the incident ion and that caused by the secondary electrons were calculated separately. (auth)

34542 (JAERI-M-5567, pp 103-108) ACCELERATED HEAVY IONS AS A TOOL FOR RESEARCH IN ATOMIC PHYSICS. Hamada, T. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Recent advances in the field of atomic physics where accelerated heavy ions are used as a tool for research are reviewed. A brief description on experimental techniques, results obtained, and also information sources is given. (auth)

34543 (JAERI-M-5567, pp 109-115) INNER-SHELL IONIZATION BY HEAVY ION IMPACT. Dependence of K-Shell Ionization on the Projectile Charge. Tawara, H. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

It is shown that the K X-ray production cross sections in low-energy heavy-ion impact are strongly dependent on the ionic charge of a projectile and the number of vacancy in the 2p shell, but not on the nuclear charge, as expected from the electron promotion model. Meanwhile, at high energies the K X-ray production cross sections are strongly dependent on both the projectile ionic and nuclear charge, which dependence is not predicted by the simple Coulomb interaction mechanism. (auth)

34544 (JAERI-M-5567, pp 116-122) EXPERIMENTAL STUDIES ON THE INNER-SHELL EXCITATION. Awaya, Y. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

X-rays from target atoms induced by 70-MeV N ion and 20-MeV α-particle bombardments were studied. Target elements were $_{24}Cr$, $_{26}Fe$, $_{29}Cu$, $_{38}Sr$, $_{47}Ag$, $_{56}Ba$, $^{144}_{60}Nd$, $_{71}Lu$, $_{82}Pb$, and $_{83}Bi$. Energy shift of K and L X-rays, the intensity ratio of Kα and Kβ X-rays and the ratio of K and L X-ray yields for both bombardments was also obtained. The experimental results suggest that the multiple inner-shell ionization seems to originate mainly in the atomic direct Coulomb interaction in this incident energy region. (auth)

34545 (JAERI-M-5567, pp 123-131) CHARACTERISTIC X-RAY EXCITATION OF Zn, Sn, Ta AND Pb BY SEVERAL MeV PROTONS AND HELIUM-3. Morita, S.; Ishii, K.; Kaji, H.; Shiokawa, T.; Tawara, H. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Absolute cross sections and excitation functions have been measured for Zn K, Sn K and L, Ta L X-ray production by proton impact and for Pb L X-ray production by proton and ^{3}He impacts over the bombarding energy range 1.4–4.4 MeV with a Si(Li) detector. The results are compared with BEA and PWBA calculations and with SCA calculation for Sn L X-ray production. Generally, a good agreement is obtained except for SCA. Ratios of X-ray production, such as Kα/Kβ and Lα/Lβ are also compared with BEA calculations. Cross-over behavior of Z_1 dependence of X-ray production cross sections is studied for Pb L lines. (auth)

34546 (JAERI-M-5567, pp 198-209) CHARGE CHANGE PROCESSES IN ENERGETIC HEAVY IONS. Tawara, H. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

The experimental results of the charge change processes of heavy ions are reviewed, giving the emphasis to the following topics: equilibrium charge distributions in gas and solid targets, effective charges in targets, charge change cross sections, angular distributions of charge fractions and doubly charged negative ions. (auth)

34547 EFFECT OF POLARIZATION OF THE ATOMIC RESIDUE ON EXCITATION CROSS SECTIONS OF OPTICAL TRANSITIONS OF ALKALI ATOMS. Beigman, I. L.; Shevel'ko, V. P. Opt. Spectrosc. (USSR) (Engl. Transl.); 37: No. 4, 353-355(Oct 1974).

Translated from Opt. Spektrosk.; 37: No. 4, 621-625(Oct 1974).

The effect of polarization of an atomic residue by an incident electron on the effective excitation cross sections of optically allowed transitions of alkali atoms is investigated. It is shown that at high collision energies the Born cross section is reduced by a factor of 1.5 to 2. Numerical computations of the cross sections for excitation by electron impact were made for the transitions K(4s–7p), Rb(5s–6p), and Cs(6s–8p). (auth)

34548 MEASUREMENT OF THE TOTAL CROSS SECTION FOR ELECTRON IMPACT EXCITATION OF 5^3P_0 METASTABLE LEVEL OF CADMIUM. Mazing, M. A.; Rakhovskii, V. I.; Stotskii, G. I.; Shustryakov, V. M. Opt. Spectrosc. (USSR) (Engl. Transl.); 37: No. 4, 464-465(Oct 1974).

Translated from Opt. Spektrosk.; 37: No. 4, 810-811(Oct 1974).

A method was devised and apparatus constructed for measuring the total excitation cross section of metastable levels of metal atoms with low vapor pressure and low excitation energy. The relative cross sections for excitation of the 5^3P_0 level of a cadmium atom by electron impact is given at 17 to 48 eV. (JFP)

34549 RESONANCE TRANSFER OF EXCITATION IN THE COLLISION OF IDENTICAL ATOMS. Strekalov, M. L. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). Dokl. Akad. Nauk SSSR; 219: No. 2, 311-314(11 Nov 1974). (In Russian).

The collision of excited atoms with a total momentum j = 1 with atoms of the same gas with the ground state j = 0 was examined. Equations were derived and numerically evaluated for the collision cross section, the excitation transfer cross section, and the width and displacement of the spectral lines. The results were compared with values obtained by other investigators. (JSR)

34550 PHOTOELECTRON ANGULAR DISTRIBUTIONS FOR ARGON AND KRYPTON IN THE 0-20 eV ELECTRON ENERGY RANGE. Watson, W. S.; Stewart, D. T. (Univ. of Glasgow). J. Phys., B (London); 7: No. 17, L466-L469(1 Dec 1974).

The angular distributions of photoelectrons ejected from the outermost p-shells of argon and krypton have been measured for electron energies up to 20 eV using polarized synchrotron radiation. Agreement between theory and experiment is found to be good. (auth)

34551 ELASTIC ELECTRON SCATTERING BY ATOMIC HYDROGEN: SECOND BORN APPROXIMATION. Zon, B. A. (Voronezh State Univ., USSR). J. Phys., B (London); 7: No. 17, L483-L485(1 Dec 1974).

The second Born amplitude for elastic electron scattering at energy 1 Ryd on the ground state of the hydrogen atom is given. (auth)

34552 POST-COLLISION INTERACTION IN ELECTRON–HELIUM SCATTERING. Heideman, H. G. M.; Niehuis, G.; van Ittersum, T. (Rijksuniversiteit Utrecht). J. Phys., B (London); 7: No. 17, L493-L495(1 Dec 1974).

It is pointed out that the so-called "displaced threshold effect", reported by Hicks et al (Proc. 8th. Int. Conf. Phys. of Electronic and Atomic Collisions, Belgrade, Abstracts p513-4 (1973) and Vacuum (to be published)) may lead to indirect excitation of atomic states under electron impact, resulting in the occurrence of structures in the excitation curves. Experimental results on the excitation of helium by electron impact have been reanalyzed and evidence is found that some structures indeed may be due to the proposed indirect excitation mechanism. (auth)

34553 ASYMMETRY IN SINGLE SCATTERING OF ELECTRONS FROM ONE-ELECTRON ATOMS. Walker, D. W. (Univ. of Edinburgh). J. Phys., B (London); 7: No. 17, L489-L492 (1 Dec 1974).

Exploratory calculations are presented which indicate that the azimuthal asymmetry in the cross section for scattering of unpolarized electrons by polarized s-state atoms in the presence of spin-orbit interaction, which was predicted by Farago (J. Phys. B. Atom. Molec. Phys.; 7: 214-8 (1974)), should be measurable for cesium at incident electron energies below about 15 eV. (auth)

34554 ON THE APPLICABILITY OF THE CLASSICAL TRAJECTORY EQUATIONS IN INELASTIC SCATTERING THEORY. Billing, G. D. (Copenhagen Univ. (Denmark). H. C. Oersted Inst.). Chem. Phys. Lett.; 30: No. 3, 391-393(1 Feb 1975).

By using the classical trajectory equations and an average trajectory the single quantum transitions for the one-dimensional atom–diatom collision problem have been predicted to within 10–30%. The double quantum transitions P_{02} are correct to within at least a factor of two. (auth)

34555 THE FREDHOLM METHOD IN LOW ENERGY ELECTRON–MOLECULE SCATTERING: STATIC EXCHANGE. Winter, T. G.; Lane, N. F. (Rice Univ., Houston, Tex. (USA). Dept. of Physics). Chem. Phys. Lett.; 30: No. 3, 363-366(1 Feb 1975).

The Fredholm method using a two-center, L^2 basis is presented for electron–hydrogen molecule scattering including exchange, but neglecting polarization. At low energies, phase shifts computed by analytically continuing the Fredholm determinant agree well with J = 0 close-coupling results. (auth)

34556 BODY-FIXED EQUATIONS FOR ATOM–MOLECULE SCATTERING: EXACT AND CENTRIFUGAL DECOUPLING METHODS. Walker, R. B.; Light, J. C. (Chicago Univ., Ill. (USA). Dept. of Chemistry). Chem. Phys. (Amsterdam); 7: No. 1, 84-93(Jan 1975).

An exact method for solving the close-coupled equations for rotationally inelastic scattering in the body-fixed (BF) coordinate representation is demonstrated by using a slight modification of the exponential method which allows application of the known boundary conditions for the space-fixed (SF) coordinate frame. The nature of the coupling in the BF frame suggests approximations which reduce the problem to a set of problems each of a smaller dimensionality. Using an atom–rigid rotor model potential, the decoupling approximation suggested by Pack and by McGuire and Kouri has been compared to the fully coupled problem. The centrifugal decoupling (CD) approximation is found to work best at low total angular momenta J, and for rotor states j. Opacity functions for inelastic transitions are generally better than ones for elastic transitions, due to errors in the phases of elastic S-matrix elements. However, at high J, CD often severely underestimates the inelastic transition probabilities. (auth)

34557 LINE WIDTH AND LINE BROADENING. Hindmarsh, W. R. (Newcastle-upon-Tyne Univ., Eng.). pp 133-173 of Atoms, Molecules, and Lasers. Vienna; International Atomic Energy Agency (1974).

See STI/PUB-356.

The treatment covers collision broadening, classical theory; quasi-static approximation; quantum theory of collision broaden-

ing; inverse power and Lennard–Jones potentials, impact approximation, quasi-static approximation, general theory, results of measurements, comparison between theory and experiment; broadening by charged particles, quadratic Stark effect, influence of inelastic collisions, and broadening through linear Stark effect. (auth)

34558 ATOMIC COLLISION THEORY. Moiseiwitsch, B. L. (Queen's Univ., Belfast). pp 471-523 of Atoms, Molecules, and Lasers. Vienna; International Atomic Energy Agency (1974).
See STI/PUB-356.
The topics discussed are scattering by a central potential; variational methods; elastic scattering of electrons by atoms; excitation of atoms by electron impact; and resonances. (auth)

34559 ANALYSIS OF ELECTRON–ATOM SCATTERING AND PHOTOIONIZATION PROCESSES. Burke, P. G. (Queen's Univ., Belfast). pp 525-566 of Atoms, Molecules, and Lasers. Vienna; International Atomic Energy Agency (1974).
See STI/PUB-356.
Low energy scattering theory and analysis of experimental results are considered including the scattering matrix and the collision cross section; partial wave analysis; fine-structure transitions; the close-coupling approximation and some recent developments; the close-coupling equations; the inclusion of higher channels; low energy electron-atom scattering; low energy electron-atom scattering; electron scattering by atomic hydrogen; electron scattering by singly ionized helium; electron scattering by alkali metal atoms; electron scattering by np^q atoms and ions; atomic photoionization processes; theory of photoelectron angular distributions; recent results for the total cross section and the asymmetry parameter; resonances in photoionization processes; and production of spin polarized electrons. (auth)

34560 COLLISIONS BETWEEN ELECTRONS AND MOLECULES. Read, F. H. (Manchester Univ., Eng.). pp 567-618 of Atoms, Molecules, and Lasers. Vienna; International Atomic Energy Agency (1974).
See STI/PUB-356.
The topics experimental techniques (guns, electron lenses, energy selectors and analysers, detectors, coincidence methods); determination of symmetries of electronic states of negative molecular ions (shape and Feshbach resonances, angular distribution theory, symmetries of N_2^- and CO_2^- resonances, selection rules for electronic transitions); determination of potential functions (dependence of cross sections on Franck–Condon overlap factors, determination from the experimental data of potential functions of excited states of H_2^-); rotational transitions in resonance reactions (selection rules for rotational transitions, rotational transitions for H_2^-, symmetries of states of H_2^-); and determination of generalized oscillator strengths for transitions in neutral molecules (generalized oscillator strength, region of validity of Born approximation, dependence of generalized oscillator strength on electronic symmetry, determination from cross section measurements, and the peculiar behavior of $\Sigma^+ \rightleftharpoons \Sigma^-$ transitions); also determination of lifetimes of excited states of neutral molecules by electron-scattering methods (the electron–photon coincidence technique, variation of lifetime with vibrational quantum number, dependence of electronic oscillator strength on internuclear distance, normalization of cross section data); preionizing states of neutral molecules (ejected electrons from atoms, ejected electrons from molecules, comparison with photoionization results) are discussed. (auth)

34561 HEAVY-PARTICLE COLLISIONS. McCarroll, R. (Universite de Bordeaux, Talence, France). pp 619-677 of Atoms, Molecules, and Lasers. Vienna; International Atomic Energy Agency (1974).
See STI/PUB-356.
Scattering by a center of force (quantum theory — summary, classical theory, classical scattering, eikonal approximation, J.W.K.B. method, high energy phase shift, validity criteria, calculation of the scattering amplitude, rainbow effect, halo (glory) effect, orbiting, reduced cross sections, resonance processes); inelastic collisions (general theory, eikonal approximation, eikonal equation — atomic and molecular representations, expansion in molecular wave functions, solution of the eikonal equation); and particular examples (the H^+–H and He^+–He systems) are discussed. (auth)

34562 HIGH-ENERGY ION–MOLECULE REACTIONS AT NONZERO SCATTERING ANGLES. Ast, T.; Terwilliger, D. T.; Cooks, R. G.; Beynon, J. H. (Purdue Univ., Lafayette, IN). J. Phys. Chem.; 79: No. 7, 708-711(27 Mar 1975).
Energy loss spectra are reported for the 10/10* reaction of argon ions upon argon at various nonzero scattering angles using a new mass spectrometric technique. The spectra obtained are in good agreement with those obtained by conventional methods. Trajectory calculations were performed in order to determine the scattering angles and the instrument transmission function. An alternative scanning technique is also described whereby a particular process can be monitored as the scattering angle is varied. (auth)

34563 ENERGY AND MASS DEPENDENCE OF THE PRODUCT YIELDS IN THE REACTION OF METHANOL WITH ACCELERATED INERT GAS IONS. Arai, E.; Takahasi, M. (Tokyo Univ. (Japan). Coll. of General Education). Chem. Lett. (Tokyo); No. 9, 975-978(Sep 1974).
Ion impact reaction of methanol was studied with accelerated inert gas ions with initial energy from 2 to 6 kV. It is shown that the yields are linear vs. $\ln E_i$, and the ratio of the average logarithmic energy loss to the reaction probability (α/p_i) was determined. The dependence of α on mass of the projectile ion is discussed. (auth)

34564 IONIZATION OF LONG-LIVED HIGHLY EXCITED STATES OF HYDROGEN AND DEUTERIUM ATOMS BY COLLISION WITH WATER MOLECULES. Shibata, T.; Fukuyama, T.; Kuchitsu, K. (Tokyo Univ. (Japan). Faculty of Science). Chem. Lett. (Tokyo); No. 1, 75-80(Jan 1974).
Long-lived highly excited Rydberg states of hydrogen (deuterium) atoms, H^{**} or D^{**}, were produced by impact of 80 eV electrons on H_2O or D_2O molecules. The ratio of the ionization cross sections forming protons and deuterons, $\sigma(D^{**}+D_2O \rightarrow D^+ + D_2O+e)/\sigma(H^{**}+D_2O \rightarrow H^+ + D_2O+e)$, was estimated from the dependence of the ion intensities on the target gas pressures to be 1.35 ± 0.15. This ratio is in close agreement with a theoretical estimate, 1.38, based on Matsuzawa's theory predicting the transfer of the rotational energy of a polar target to the Rydberg electron when the excited atom is ionized. (auth)

34565 SLOW NEUTRON SCATTERING BY ONE-DIMENSIONAL ROTOR AND MATHIEU FUNCTION. Inoue, K. (Hokkaido Univ., Sapporo (Japan). Faculty of Engineering). Hokkaido Daigaku Kogakubu Kenkyu Hokoku; No. 69, 147-158(Nov 1973). (In Japanese).
While neutron scattering is a powerful tool for studying the internal rotations of molecules, it is necessary to perform considerable theoretical and numerical calculations. The expression of incoherent neutron scattering cross section from a hydrogen atom in one-dimensional rigid rotor was obtained. To compute this scattering cross section the Mathieu eigenvalues and eigenfunctions are necessary, and the latter appears in a form of matrix element of the exponential function $\exp(im\theta)$. Appropriate procedures for calculating these quantities are also given. (auth)

34566 SEMI-CLASSICAL THEORY FOR DIFFERENTIAL AND TOTAL SCATTERING CROSS SECTIONS WITH APPLICATION TO ELECTRON–ATOM, ION–ATOM AND ATOM–ATOM SCATTERING. McCann, K. J. Atlanta; Georgia Inst. of Tech. (1974). 153p. University Microfilms Order No. 74-30,068.
Thesis (Ph. D.).
A semi-classical theoretical treatment of elastic and inelastic collisions is developed. The relative motion of the colliding systems is described by a generalization of the eikonal approximation, and the internal electronic motion of the systems is treated by a multistate expansion. The theory is applied to the calculation of differential and total cross sections for electron–atom, ion–atom, and atom–atom collisions, and the comparison with available experimental data is found to be excellent. Further, it is shown that by adopting simplifying approximations, the present theory yields formulas presented by other investigators. The relations between these various theories are examined, and the inadequacies of the earlier theories are displayed. (Diss. Abstr. Int., B)

34567 NON-ADIABATIC INTERACTIONS AND THE TRANSLATIONAL FACTOR IN HEAVY-PARTICLE COLLISIONS. Hatton, G. J. La Jolla, San Diego, CA; Univ. of California (1974). 188p. University Microfilms Order No. 75-8260.
Thesis (Ph. D.).
The theory of electronic transitions in heavy-particle collisions is studied in the framework of the perturbed stationary-state formalism of Chen and Watson. The formalism, in which translational factors arise naturally, is presented in a particle-conserving form. The "coupling hypothesis," the noncrossing rules, the adiabatic-diabatic question, and the effect of the theory on the nonadiabatic electronic matrix elements are studied. An eight molecular state calculation, for incident laboratory energies of 0.5 K to 1.6 keV is performed. (Diss. Abstr. Int., B)

34568 HALF SPACE MODELS FOR GAS–SURFACE INTERACTION. Cercignani, C.; Lampis, M. (ARS, Milan). pp 361-368 of Rarefied Gas Dynamics. Karamcheti, K. (ed.). New York; Academic Press, Inc. (1974).

From 8th international symposium on rarefied gas dynamics; Stanford, California, USA (Jul 1972). See CONF-720740-.

An equation whose solution provides "scattering kernels" for gas–surface interaction is discussed; all the previously known "scattering kernels" are shown to be related to its solution; some new kernels are proposed. (auth)

Atomic Theory

Refer also to abstract 34723.

34569 ATOMIC SPECTROSCOPY SUM RULES AND THE UNCERTAINTY RELATION. Gardavsky, J. (Charles Univ., Prague). Collect. Phenomena; 1: No. 4, 193-194(Jul 1974).

The sums for electron transitions in atoms are reconsidered in terms of the commutator technique by making use of a slightly different physical interpretation of the sums than the usual one. The hydrogen atom is considered as an example. (JFP)

34570 THEORY OF ATOMIC STRUCTURE AND TRANSITION PROBABILITIES. Feneuille, S. (Universite de Paris Sud, Orsay, France). pp 3-56 of Atoms, Molecules, and Lasers. Vienna; International Atomic Energy Agency (1974).

See STI/PUB-356.

General features of atomic structure theory are discussed including atomic constants; atomic Hamiltonians and their symmetry properties; and approximation methods. Elements of group theory are treated covering fundamental properties; conjugate elements—classes; matrix representations—characters; Kronecker product; and the Wigner–Eckart theorem. The rotation group in three dimensions is studied under the aspects of infinitesimal rotations and angular momenta; classes and irreducible representations; Kronecker products—3j symbols; and recoupling coefficients—nj symbols. Tensor operators are considered as a definition of irreducible tensor operators; the Wigner–Eckart theorem; coupled tensor operators; elementary tensor operators; and atomic interactions under tensorial form. Configurations of two electrons are given as L-S coupling; j-j coupling; the validity of various couplings; and electrons in closed subshells. Antisymmetry problems cover nonequivalent electrons; equivalent electrons CPF; and second quantization. Static fields include uniform magnetic field—Zeeman effect; and uniform electric field—Stark effect. Field quantization and radiative processes are quantized free electromagnetic field; general formulas for transition probabilities; and one-photon radiative processes. Electric dipole radiative transitions are discussed covering line and multiplet factors; and transition integrals. Relativistic effects in atomic spectra are treated as the Dirac equation; electron in a central field; Fouldy–Wouthuysen transformation and Breit interaction—Breit–Pauli approximation. (auth)

34571 THEORY OF ATOMIC STRUCTURES, TRANSITIONS, AND MOLECULAR POTENTIAL CURVES WITH ELECTRON CORRELATION IN GROUND AND EXCITED STATES. Sinanoglu, O. (Yale Univ., New Haven). pp 57-91 of Atoms, Molecules, and Lasers. Vienna; International Atomic Energy Agency (1974).

See STI/PUB-356.

The coverage includes new atomic-structure theory with electron correlation; theory of the N-electron excited state; the all-external correlation E_{IJ} and energy levels; transition probabilities; molecular binding and potential energy curves; the semi-internal correlation effect and molecular potential energy curves; and the charge wave function and charge distribution related properties of molecular excited states. (auth)

34572 OBSERVED STRUCTURE OF ATOMIC SPECTRA. Edlen, B. (Lund Univ., Sweden). pp 93-131 of Atoms, Molecules, and Lasers. Vienna; International Atomic Energy Agency (1974).

See STI/PUB-356.

The discussion covers the central-field model of the atom; nucleus plus one electron; closed shells plus one electron (Rydberg series, iso-electronic sequences); closed shells plus two electrons; series limits and ionization energies; the Ritz formula; the polarization formula; ionization energies as functions of Z and N; level intervals in iso-electronic sequences; "electrostatic" intervals; spin-orbit intervals; wave numbers of transitions; survey of electron configurations and term systems; ground configurations in the first half of the periodic system (structure of 2- to 10-electron systems, 11- to 18-electron systems, N = 19–28, $3d^k$ configurations); ground configurations for N ≥ 47; and a brief survey of literature. (auth)

34573 RADIOFREQUENCY SPECTROSCOPY. Kastler, A. (Ecole Normale Superieure, Paris). pp 175-211 of Atoms, Molecules, and Lasers. Vienna; International Atomic Energy Agency (1974).

See STI/PUB-356.

The discussion of radiofrequency spectroscopy covers special features of RF transitions (predominance of induced emission; electric dipole transitions and magnetic dipole transitions; the width and shape of RF lines; the Doppler width; the natural line width; broadening effects); a short historical survey; production and detection of RF transitions; the two classes of detection methods: change in the wave properties and change in the properties of matter (Rabi's detection method of molecular beams; the optical detection method of RF resonances; orientation or polarization and alignment; and atomic orientation and magnetization at thermal equilibrium. Also covered are detection by transfer of angular momentum; detection by nuclear physics techniques; the electronic detection methods of RF resonance); the behavior of paramagnetic atomic states in a constant field and in a radiofrequency field (definitions; behavior of an atomic system in a constant field; behavior of a collection of many identical paramagnetic atoms in a constant field; behavior of a collection of atoms in an RF field; classical theory of the motion of a spin submitted to a constant field and an RF field); results (study of pure Zeeman intervals; fine-structure intervals of the n = 2 level of the hydrogen atom; hyperfine-structures in atomic ground states; muonium $e^-\mu^+$; and positronium e^-e^+). (auth)

34574 NUCLEAR EFFECTS IN ATOMIC SPECTRA. Bauche, J. (Laboratoire Aime Cotton, Orsay, France). pp 213-240 of Atoms, Molecules, and Lasers. Vienna; International Atomic Energy Agency (1974).

See STI/PUB-356.

Hyperfine structure; line structure interpretation; electromagnetic properties of the nucleus; theory of magnetic-dipole hyperfine structure (sublevels, transitions); electric-quadrupole hyperfine structure; hyperfine-structure constants; configuration interaction, and hyperfine-structure anomaly are discussed. Also isotope shift theory; the co-existence of mass and field isotope shift; order-of-magnitude estimates; King graphs; and theoretical approaches are treated. (auth)

34575 HIGHLY EXCITED ATOMS. Percival, I. C. (Univ. of Stirling, Scotland). pp 241-260 of Atoms, Molecules, and Lasers. Vienna; International Atomic Energy Agency (1974).

See STI/PUB-356.

The coverage includes elementary properties; the correspondence principle for intensity of radiation; classical collisions; classical cross sections; discrete states and correspondence principles; and a discussion of literature. (auth)

34576 THEORY OF SUPERLUMINESCENCE IN A DISPERSIVE MEDIUM WITH MOLECULAR RELAXATION. Bogdanova, M. V.; Il'inova, T. M.; Khokhlov, R. V. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 68: No. 2, 469-478(Feb 1975). (In Russian).

Results are presented of a theoretical investigation of superluminescence (SL) in molecular media (organic dyes, CO_2 molecules). The calculations are based on a three-level model in the approximation of a prescribed momentum pumping field under the condition that the SL produced does not affect the population motion of the levels. Molecular relaxation processes are taken into account. The influence of group retardation effects on the formation of SL pulses is studied. It is shown that simultaneous action of dispersion and transverse relaxation leads to stationary shape SL pulses with exponential amplification. The amplitude profiles of the stationary SL pulses are investigated. (auth)

34577 VACUUM POLARIZATION AND THE ENERGY SHIFT FOR THE INNER ELECTRONS IN HEAVY ATOMS. Kovalevskii, A. G.; Labzovskii, L. N. Vestn. Leningrad. Univ., Fiz., Khim.; 16: No. 3, 16-21(Aug 1974). (In Russian).

The energy shift for the inner electrons in heavy atoms caused by the vacuum polarization is obtained by the expansion of the electron propagator in powers of the potential of the nucleus. The terms containing divergences are singled out. These divergences are then removed by the usual covariant method. The remainder of series is summed approximately with the aid of the variational principle. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

34578 (AD/A-000146) ITERATION METHOD FOR EQUATIONS CALCULATING TWO-DIMENSIONAL MHD FLOWS. Ostretsov, I. N.; Petrosov, V. A. 22 Oct 1974. Translated by M. Olaechea from pp 254-257 of Plazmennye Uskoriteli, Moscow, 1973. (FTD-HT-23-1090-74). 12p. NTIS $3.25.

34579 KINEMATICAL STUDY OF THE MHD FLOW BEHIND A SHOCK WAVE. Ram, R.; Singh, B.; Sharma, V. D. (Banaras Hindu Univ., India). Istanbul Univ. Fen Fak. Mecm., Seri A; 37: 107-112(1974).

The pressure variation is discussed along the tangent, principal normal and binormal to stream lines. The rotational flow is assumed and the vorticity is determined in intrinsic form. The existence of a stationary shock wave is assumed and the flow is examined at the rear of the shock surface. The curvature of a stream line at the rear of the shock surface is determined in terms of the shock geometry and the flow conditions ahead of the shock. (auth)

34580 MAGNETOHYDRODYNAMIC THEORY OF STABILITY OF VISCOUS MACLAURIN SPHEROIDS. Oganesyan, R. S.; Abramyan, M. G.; Ekelekyan, V. L. (Erevan State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 9: No. 3, 240-247(1974). (In Russian).

The problem of Maclaurin spheroids stability in the presence of toroidal magnetic field is considered with due regard for small viscosity relative to n = m = 2 type of excitations which are predominant in the theory of spheroids stability. It was shown in the linear theory framework, that the small kinematic viscosity ν in the presence of low order toroidal magnetic field $\nu^{1/4}$ deflects the limiting point of stability to the left from bifurcation point and changes the oscillation frequency. It was also shown that magnetic fields of the order of ν' had no effect on the stability of the spheroids when r > 0.25. (auth)

34581 SCALAR POTENTIAL FOR THE PROPAGATION OF MAGNETIC WAVE IN MAGNETO-PLASMATIC MEDIUM. Ivanov, K.; Ganchev, S. pp vp of Second National Conference of the Young Physicists. Sofia; Komitet za Mirno Izpolzuvane na Atomnata Energiya (1974). (In Bulgarian).

From 2nd national conference of the young physicists; Sofia, Bulgaria (10 Apr 1974).

The propagation of a monochromatic electromagnetic wave in unbounded magneto-plasmatic medium parallel to an external constant magnetic field is studied. The permeance of the medium is a scalar quantity, the dielectric constant is a tensor, which is a function of the plasmatic and cyclotronic frequencies, the collision frequency and the monochromatic wave frequency. It is shown, that the components of the electromagnetic field satisfy the condition for the existence of a scalar potential function, satisfying a fourth order differential equation. The latter may be represented as the consequent appliance of two second order differential operators to the scalar potential function, which is written as a linear combination of the solutions of the two second order differential equations. The components of the electric and magnetic vectors along the coordinate axes of the monochromatic wave are determined from the scalar potential by differentiation. (INIS)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 34629.

34582 (CERN-74-23, pp 271-366) DATA ANALYSIS TECHNIQUES FOR HIGH ENERGY PARTICLE PHYSICS. Friedman, J. H. (Stanford Linear Accelerator Center, CA). 15 Nov 1974.

In proceedings of the 1974 CERN school of computing, Godoeysund, Norway, 11–24 August 1974.

Useful techniques for the statist'cal analysis and presentation of high energy particle physics data are described and discussed. (auth)

Electromagnetic

Refer also to abstract 33271.

34583 MEASURING THE NEUTRON–ELECTRON INTERACTION BY DIFFRACTION OF SLOW NEUTRONS ON ^{186}W MONOCRYSTALS. Aleksandrov, Yu. A.; Machekhina, T. A.; Sedlakova, L. N.; Fykin, L. E. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 20: No. 6, 1190-1195(Dec 1974). (In Russian).

The monocrystals of two different isotopic mixtures of tungsten enriched with the isotope ^{186}W and having coherent scattering amplitudes of opposite sign were studied by neutron radiography. It is shown that the theoretical description of the results becomes possible under the assumption that an additional scattering contributes to the Bragg maxima. (4 figures) (auth)

Weak

34584 (PITHA-79-74) NEW RESULTS FROM NEUTRINO EXPERIMENTS. Faissner, H. (Technische Hochschule Aachen (F. R. Germany). 3. Physikalisches Inst.). 1974. 48p. (In German). (AED-CONF-74-093-002). INIS.

From spring meeting of the Deutsche Physikalische Gesellschaft e.V.: expert committee on nuclear and high-energy physics; Hamburg, F. R. Germany (20 Feb 1974).

With abstract.

A detailed survey is given of essential results from neutrino experiments. The main results are evidence for additivity of muonic quantum number, exclusive reactions $\nu N \to \mu N'$, $\nu N \to \nu \Delta$ and elastic production of hyperons $\text{anti}\nu p \to \mu^+ \Lambda^0(\Sigma^0)$, inclusive inelastic reactions and quark-gluon-structure of nucleons, semileptonic and leptonic neutral currents. Uniform, divergence-free gauge theory of weak and electromagnetic interaction is also discussed. (GE)

34585 RESULTS OF THE NEUTRAL CURRENT SEARCH IN GARGAMELLE. Morfin, J. G. (Technische Hochschule, Aachen). pp 323-360 of Particle Interactions at Very High Energies. Part B. Speiser, D. (ed.). New York; Plenum Publishing Corp. (1974).

From 2nd summer institute on particle interactions at very high energies; Louvain, Belgium (12 Aug 1973). See CONF-730863–PB.

The angular and energy distributions are plotted for $\bar{\nu}_\mu + e^- \to \bar{\nu}_\mu + e^-$ interactions. It is found that the cross sections for purely leptonic neutral currents are exactly calculable from the Weinberg–Salam models. (JFP)

34586 GAUGE THEORIES AND THE NEUTRAL CURRENT: NEW DEVELOPMENTS IN WEAK INTERACTIONS. Rajasekharan, G. (Tata Inst. of Fundamental Research, Bombay (India)). Phys. News (India); 5: No. 1, 6-14(Mar 1974).

The history of the development of weak interaction physics is reviewed. Recent developments have been discussed with a view to bringing out an acceptable theory of weak interactions. The developments are centered around gauge theories and the salient features of these theories are described. These include: (1) the introduction of the W bosons; (2) conservation of currents; (3) breakdown of symmetry and (4) the incorporation of the electromagnetic interaction. The special feature of this approach is the prediction of neutral-current weak interactions. Results of the experiment performed at CERN to detect these events are presented. The ratio of the antineutrino to the neutrino cross section is calculated using axial vector currents. The detection of the neutral-current weak interaction has been quite significant in bridging weak and electromagnetic interactions. (INIS)

34587 HARD-CORE OF ELECTRONS AND NEUTRAL CURRENTS. New Indications at Last of the Trinity of the Elementary Interactive Forces. Fahr, H. J. (Bonn Univ. (F. R. Germany). Sternwarte). Phys. Bl.; 30: No. 10, 457-460 (Oct 1974). (In German).

Unification of weak and electromagnetic interactions seems to require the existence of neutral currents and new heavy leptonic particles. Neutrino and electron-positron storage ring experiments are described and the results interpreted as an indication of trinity of weak, electromagnetic and strong interactions. (GE)

34588 MULTIPLE SCATTERING OF COSMIC RAY MUONS ABOVE 2.5 GeV/c. Osborne, A. R. Houston, TX; Univ. of Houston (1974). 291p. University Microfilms Order No. 75-8248.

Thesis (Ph. D.).

The multiple scattering of cosmic ray muons in a magnetic momentum spectrometer was investigated both theoretically and experimentally. Theoretically, the multiple scattering theory of Molière was modified to account for observations made with magnetic spectrometers. Experimentally, 8000 muon events were analyzed in the momentum region 2.5 to 200 GeV/c for a target thickness of one meter of iron. Good agreement is found between the theoretical and experimental results. (Diss. Abstr. Int., B)

Strong (Baryon-induced)

Refer also to abstracts 34796 and 35003.

34589 (ANL/HEP-75-02, pp II.1-II.25) POLARIZATION IN PROTON–PROTON SCATTERING. Miller, D. H. (Northwestern Univ., Evanston, IL). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

Only the most general features of an interaction involving particles with spin are revealed in the total and differential cross sections. It is necessary to study polarization phenomena to extract the detailed nature of the spin dependence of the interaction. With an adequate number of independent measurements this culminates in a model-independent determination of the scattering amplitude. This brief review will be limited to measurements in p–p scattering above 1 GeV/c. Although much work has been done it will become apparent that a great deal remains before the full scattering amplitude can be determined. (auth)

34590 (ANL/HEP-75-02, pp III.1-III.26) SPIN DEPENDENCE IN INELASTIC SCATTERING. Wicklund, A. B. 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

A review is given of experimental work in progress on inelastic nucleon nucleon interactions with the ZGS polarized beam. The available results come from the Effective Mass Spectrometer (EMS) at 6 GeV/c. This repertoire should expand in time both in the range of beam momenta and in the experimental facilities employed. In particular a survey experiment has taken 12' bubble chamber film and a study of coherent N^* production off ^4He is planned for the Streamer Chamber. Attention is confined to EMS results, indicating those physics opportunities that are moldering for lack of attention. (auth)

34591 (ANL/HEP-75-02, pp V.1-V.19) NEW SYSTEMATICS IN HADRON TOTAL CROSS SECTIONS. Lipkin, H. J. 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

Experimental data for the quark model expression $\sigma(\phi p) = \sigma(K^-p) + \sigma(K^+p) - \sigma(\pi^-p)$ and the peculiar linear combination $(\frac{3}{2})\sigma(K^+p) - (\frac{1}{2})\sigma(pp)$ are equal and monotonically rising as a + b log s over the entire 2–200 GeV/c range. A new third component exhibiting a striking scaling behavior is shown to be present in total cross sections and to explain these and other unexplained effects: (1) The $\sigma(\pi N) - \sigma(KN)$ difference, (2) the deviation of $\sigma(\pi N)/\sigma(NN)$ from $\frac{2}{3}$, (3) differences in energy behavior of cross sections, particularly the decrease in $\sigma(pp)$ at low energies, (4) the differences $\sigma(K^+p)$, $\sigma(pp)$ and $\sigma(\phi p)$ which are all pure Pomeron in two-component duality. (auth)

34592 (ANL/HEP-75-02, pp IX.1-IX.5) SPIN DEPENDENCE IN p–p INTERACTIONS AT 6.0 GeV/c. Fernow, R. C. (Univ. of Michigan, Ann Arbor). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

A few brief comments are made on the results the Argonne-Michigan-St. Louis collaboration have obtained thus far in their study of the spin dependence of the pp interaction at 6.0 GeV/c. (LBS)

34593 (ANL/HEP-75-02, pp XXV.1-XXV.26) STRUCTURES IN PROTON-PROTON ELASTIC SCATTERING (MAINLY AT ARGONNE ZGS ENERGIES) AND THEIR INTERPRETATION. Hendry, A. W. (Indiana Univ., Bloomington). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22-26, 1974.

Experimental data on pp elastic scattering show clear structure in $d\sigma/dt$ vs t at values $-t \approx 1.3$ $(GeV/c)^2$ (from the slope), in polarization P vs t at values $-t \approx 0.8, 2.5, 5.5$ $(GeV/c)^2$ (dips or double zeros), and in fixed angle $(d\sigma/dt)_0$ vs t at $-t \approx 1.3, 6, \ldots$ $(GeV/c)^2$. It is suggested these structures seem to arise naturally from the oscillations of amplitudes which are dominated by diffractive and peripheral contributions. The s-channel presents a simple physical picture for the scattering process, and provides a straightforward interpretation of the observed structures. (LBS)

34594 (ANL/HEP-75-02, pp XXVIII.1-XXVIII.10) MEASUREMENT OF POLARIZATION IN p-n ELASTIC SCATTERING. Ayres, D. S. 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22-26, 1974.

An experiment to be performed with the ZC5 polarized beam incident on a deuterium target, using the effective mass spectrometer to measure the momentum and angle of the fast scattered proton, is described. Data will be obtained at four energies between 2 and 6 GeV/c in the momentum transfer range $0.12 \gtrsim |t| \gtrsim 0.8$ GeV^2, with 250,000 pn elastic scatters at each energy. The results expected from the experiment are discussed. (LBS)

34595 (ANL/HEP-75-02, pp XXIX.1-XXIX.8) PRACTICAL THOUGHTS ON MEASURING p-p AMPLITUDES. Sandler, B. 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22-26, 1974.

Attention is given to the details which must be considered in a program to measure the pp amplitudes. The number of feasible experiments which can be currently considered at the ZC-S is given. (LBS)

34596 (ANL-HEP-7466) POLARIZED PROTON BEAM PHYSICS AND RELATED TOPICS. Wicklund, A. G. (Argonne National Lab., Ill. (USA)). [nd]. 5p. (CONF-740713-37). Dep. NTIS $4.00.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

Recent results from the polarized proton beam facility at the Argonne Zero Gradient Synchrotron are reported. Some features of the beam that are important in designing experiments are underlined. Results are reported on np elastic cross section, $pp \rightarrow pp$ interactions at 6 GeV, spin correlations in $pp \rightarrow \Delta^{++}$ interactions at 6 GeV; $pp \rightarrow \Delta^{++}n$ interactions at 6 GeV; and backward π^-p elastic polarization. (LBS)

34597 (COO-3065-107) NEUTRAL BEAM STUDIES OF COHERENT PRODUCTION ON NUCLEI FROM 6-16 GeV/c. Carithers, W. C. Jr. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy). 20 Jan 1975. Contract AT(11-1)-3065. 17p. (CONF-740984-2; UR-517). Dep. NTIS $4.00.

From international conference on high energy collisions involving nuclei; Trieste, Italy (9 Sep 1974).

The discussion of coherent production from nuclei at 6 to 16 GeV/c covers the experimental technique, measurement of the total cross section for unstable $(p\pi^-)$ states in nuclear matter, Coulomb production of $\Delta(1236)$ and $K^{*0}(890)$, and resonance production. Histograms for numbers of events for neutron reactions with carbon and lead and neutral kaon reactions the lead are shown. The results are preliminary. (JFP)

34598 (CRN-HE-74-19) ANTIPROTON-DEUTERIUM INTERACTIONS AT 14.6 GeV/c. Fridman, A. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires; Strasbourg-1 Univ., 67 (France)). 1974. 7p. INIS.

From symposium on antinucleon-nucleon interactions; Prague, Czechoslovakia (24 Jun 1974).

This paper presents some results on the $\bar{p}d \rightarrow p_s\bar{p}p\pi^-$ and $\bar{p}d \rightarrow \bar{p}d\pi^+\pi^-$ reactions at 14.6 GeV/c. Using events with a visible spectator proton (p_s) stopping in the chamber, a cross section of 730 ± 50 μb is obtained for the $\bar{p}d \rightarrow p_s\bar{p}p\pi$ reaction. Some weak $\bar{\Delta}$-resonance production is observed, but the marked feature consists of a low-mass $(p\pi^-)$ enhancement at 1.4 GeV/c^2. The comparison of the $\bar{p}n\bar{\Delta}$-reaction with the line-reversed reaction $pp \rightarrow \Delta^{++}n$ is achieved. A detailed study of the 1.4-GeV/c^2 $(p\pi^-)$ enhancement suggests a contribution of a diffractive dissociation mechanism in which $n \rightarrow p\pi^-$. A cross section of 0.30 ± 0.07 mb was obtained for the $\bar{p}d \rightarrow \bar{p}d\pi^+\pi^-$ channel. This reaction is dominated by d^* $d\pi^+$ effect and $\bar{\Delta}$-production. Furthermore, some indication of a diffraction dissociation process of the incident $\bar{p}$ into $\bar{p}\pi^+\pi^-$ is seen. (FR)

34599 (JINR-E1-8456) TOTAL ELASTIC PROTON-PROTON CROSS SECTION FROM 9 TO 300 GeV/c. Bartenev, V.; Kuznetsov, A.; Morozov, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 9p. Dep. NTIS (US Sales Only) $4.00.

Values of σ_{el} in pp collisions in the range $9 \leq p \leq 300$ GeV/c are reported. (auth)

34600 (N-74-29155) NUCLEAR REACTIONS INDUCED BY HIGH-ENERGY ALPHA PARTICLES. Final Report, 1 July 1970-30 September 1974. Shen, B. S. P. (Pennsylvania Univ., Philadelphia (USA). Dept. of Astronomy). 30 Sep 1974. 10p. (NASA-CR-138903). NTIS $4.00.

Experimental and theoretical studies of nuclear reactions induced by high energy protons and heavier ions are included. Fundamental data needed in the shielding, dosimetry, and radiobiology of high energy particles produced by accelerators were generated, along with data on cosmic ray interaction with matter. The mechanism of high energy nucleon-nucleus reactions is also examined, especially for light target nuclei of mass number comparable to that of biological tissue. (STAR)

34601 (RLO-2225-T27-5) PROGRESS REPORT FOR PERIOD MAY 15, 1974-February 5, 1975. Lord, J. J.; Wilkes, R. J. (Washington Univ., Seattle (USA). Dept. of Physics). 5 Feb 1975. Contract AT(45-1)-2225. 14p. Dep. NTIS $4.00.

Progress was made in the study of high energy particle interactions with heavy nuclei. Emulsions with granule targets of C, Cr, Ag, and W were exposed to 300-GeV proton beams at NAL. Preliminary results for Ag and W are presented; the observed multiplicity and pseudorapidity distributions appear to favor the two-phase model (TPM) of Fishbane and Trefil, or the modified energy flux cascade (EFC) model. Presently consultations are made with Dr. J. L. Rosner regarding expected signatures of charmed-particle decays which might be present in our NAL-exposed plates. The request for an exposure to the Bevelac Ar beam has been approved by the Bevelac Program Advisory Committee, and the experiment is expected to be scheduled in April 1975. (auth)

34602 (USIP-74-01, pp 1-5) PROPOSAL TO STUDY π^0 PRODUCTION IN 19 GeV/c pp INTERACTIONS IN BEBC. Summary of Research Project. Jan 1974.

In Particle Physics Group annual report, 1973.

A summary is given of a proposal to study π^0 production at 19 GeV/c pp interactions in a bubble chamber. (JFP)

34603 PARTICLE PHYSICS IN SERPUKHOV. Logunov, A.; Yarba, V. Veda Tech. SSSR; 2: No. 3, 5-11(1974). (In Czech).

Reviewed are the principal trends of research into elementary particle physics in the Institute of High Energy Physics near Serpukhov, conducted by means of the 70 GeV proton accelerator. Experiments are listed serving the investigation of inclusive processes of the production of pions, kaons, and of antiprotons and the interactions thereof. The Serpukhov effect, the research into quarks and into the antiparticle production are briefly discussed. (INIS)

34604 TOPICS IN PARTICLE PHYSICS WITH COLLIDING PROTON BEAMS. Sens, J. C. (CERN, Geneva). pp 61-182 of Particle Interactions at Very High Energies. Part A. Speiser, D. (ed.). New York; Plenum Publishing Corp. (1974).

From 2nd summer institute on particle interactions at very high energies; Louvain, Belgium (12 Aug 1973). See CONF-730863-PA.

The lectures on particle physics with colliding proton beams cover the basic characteristics of the CERN ISR, ISR performance and development, one-particle inclusive distributions, summary of low energy missing-mass data, high energy ($s > 100$ GeV^2) missing mass experiments, and high energy missing mass data and the triple-Regge limit. (JFP)

34605 INTERACTION OF MULTICHARGED PARTICLES OF GALACTIC COSMIC RADIATION ($Z \geq 3$, E-BAR = 1.4 GeV/NUCLEON) WITH HEAVY EMULSION NUCLEI. Potapov, Yu. V.; Khokhlova, Z. S.; Shimanskaya, N. S.; Yakovlev, R. M. Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1824-1826(Sep 1974). (In Russian).

The nuclear-nuclear interactions obtained during the irradiation of emulsion chambers with cosmic radiation in the stratosphere were analyzed. Stars formed during the interaction of multicharged particles of galactic cosmic radiation with heavy emulsion nuclei were selected for the analysis. The angular distribution of

the relativistic α particles, the dependence of the mean number of black particles to the number of grey particles, and the dependence of the mean number of grey particles on the number of singly charged relativistic particles were determined. An analysis of the experimental data indicated that during the interaction of nuclei with nuclei the characteristics of the secondary particles are such as to make impossible correlation with the independent nucleon-nuclei interaction model. (JSR)

34606 PROTON DIFFRACTIVE EXCITATION IN THE REACTION $K^-p \rightarrow K^-p\pi^+\pi^-$ AT 16 GeV/c. Otter, G.; Rudolph, G.; Seyfert, H. (Technische Hochschule Aachen (F. R. Germany). 3. Physikalisches Inst.); Kaufmann, H. H.; Vogt, H. (Akademie der Wissenschaften der DDR, Berlin); Coghen, T.; Humble, S.; Kuhn, D.; Morrison, D. R. O. (European Organization for Nuclear Research, Geneva (Switzerland)); Bacon, T. C. Nucl. Phys., B; 87: No. 1, 1-18(24 Feb 1975).

By means of kinematic cuts, 1421 events of the reaction $K^-p \rightarrow K^-p\pi^+\pi^-$ at 16 GeV/c which involve the diffractive excitation of the proton are selected. Decay of the diffractive cluster is most simply described in the Gottfried-Jackson reference frame, where a highly anisotropic decay is observed. The cluster, containing spin components $J \geq 5/2$, has a dominant decay mode $\Delta^{++}(1236)\pi^-$. (auth)

34607 THE PRODUCTION OF CHARGED PARTICLES WITH HIGH TRANSVERSE MOMENTUM IN PROTON-PROTON COLLISIONS AT THE CERN ISR. Alper, B.; Boeggild, H.; Booth, P.; Carroll, L. J.; von Dardel, G.; Damgaard, G.; Duff, B.; Jackson, J. N.; Jarlskog, G.; Joensson, L. Nucl. Phys., B; 87: No. 1, 19-40(24 Feb 1975).

Results are given on the inclusive production of charged pions, kaons and nucleons in high-energy proton-proton collisions in the centre-of-mass rapidity range $|y_{cm}| < 1$ and for transverse momenta up to 4.8 GeV/c. The dependence of the composition of produced particles on y_{cm}, the total energy $\sqrt{s}$, and transverse momentum P_T is discussed. (auth)

34608 TRANSVERSE MOMENTUM TRANSFER IN pp INTERACTIONS. Bialas, A.; Eskreys, A.; Franz, H.; Sakai, N.; Schrankel, W. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)); Blobel, V.; Fesefeldt, H.; Roedel, R. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)); Heilmann, H. G.; Idschok, U. (Bonn Univ. (F. R. Germany). Physikalisches Inst.). Nucl. Phys., B; 86: No. 3, 365-380(17 Feb 1975).

Transverse momentum transfer is investigated as a function of rapidity. At a given rapidity value y, the transverse momentum transfer is defined as the sum of the transverse momentum vectors of all particles in an event with $y < \bar{y}$ (or $y > \bar{y}$). It is argued that this is a sensitive measure of the correlations between transverse momenta of particles. The experimental distributions of this transfer are given for pp interactions at 12 and 24 GeV/c. A comparison with the uncorrelated and multiperipheral models is presented. (auth)

34609 MOMENTUM SPECTRA OF SECONDARY PARTICLES PRODUCED IN PROTON-PROTON COLLISIONS AT 14.2, 19.2, AND 24.0 GeV/c. Amaldi, U.; Biancastelli, R.; Bosio, C.; Matthiae, G. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica); Allaby, J. V.; Diddens, A. N.; Dobinson, R. W.; Klovning, A.; Litt, J.; Rochester, L. S. Nucl. Phys., B; 86: No. 3, 403-440(17 Feb 1975).

Results on charged particle yields in proton-proton collisions at 14.2, 19.2 and 24.0 GeV/c for secondary momenta above 4 GeV/c and lab angles between 10 and 150 mrad are reported. Cross sections for inclusive reactions involving the production of $\pi^\pm$, $K^\pm$, p and $\bar{p}$ are presented. The general features of the dependence of the data on transverse and longitudinal momentum, missing mass, and four-momentum transfer are described and the approach to limiting distributions in the 10 to 30 GeV energy range is discussed. (auth)

34610 CHARGE EXCHANGE IN THE DEUTERON BREAK UP AT 3.3 GeV/c INCIDENT DEUTERON MOMENTUM. Aladashvili, B. S.; Glagolev, V. V.; Lebedev, R. M.; Nioradze, M. S.; Saitov, I. S.; Streltsov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR)); Badelek, B.; Siemiarczuk, T.; Stepaniak, J. (Warsaw Univ. (Poland). Instytut Fizyki Doswiadczalnej); Nassalski, J. Nucl. Phys., B; 86: No. 3, 461-478(17 Feb 1975).

The charge exchange deuteron break up $dp \rightarrow npp$ was studied at 3.33 GeV/c deuteron momentum in the 1 m hydrogen bubble chamber. The contribution of the spin-independent amplitude to the $np \rightarrow pn$ charge exchange reaction for low t values was estimated. Various mechanisms playing a role in the process considered are discussed. (auth)

34611 SOME MEASUREMENTS OF THE TRANSVERSE MOMENTUM DISTRIBUTION OF pp-SECONDARIES AT THE CERN-ISR. Cohen, J. I.; Friedlander, E. M. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 19: No. 9, 959-962 (1974).

Two recent measurements of the p_T-distribution at fixed-x at the CERN-ISR are discussed from the point of view of both their mutual compatibility and their internal consistency. It is shown that the data of Bertin et al. though internally consistent, are not compatible with those of Albrow et al. in practically the same x-interval. (auth)

34612 NUCLEAR SPIN-ROTATIONAL INTERACTION IN VIBRATING MOLECULES. I. The Theory of Proton Spin-Rotational Interaction. Rebane, T. K.; Volodicheva, M. I. Vestn. Leningrad. Univ., Fiz., Khim.; 22: No. 4, 55-60(Nov 1974). (In Russian).

The modified Pauli equation for a proton and the results of the molecular gyromagnetism theory were used to obtain the proton spin-rotation constant in order to remove the ambiguity existing in literature. The results show that the whole relativistic correction due to possible proton displacement from the equilibrium position is reduced to Thomas precession correction with the accuracy of order v^2/c^2 inclusive. (auth)

34613 INCLUSIVE REACTIONS pN → pX BETWEEN 50 AND 400 GeV. Robinson, B. W. New Brunswick, NJ; Rutgers-The State Univ. (1974). 99p. University Microfilms Order No. 75-8435.

Thesis (Ph. D.).

The inclusive cross sections of the reactions pp → pX and pd → pX are measured in the range $100 < s < 750$ GeV^2, $0.14 < -t < 0.38$ GeV^2, and $0.81 \lesssim x \lesssim 0.92$. The inclusive cross sections of the reaction pn → pX are determined from these cross sections. The results are parameterized in terms of triple Regge theory. The experiment was performed at the Internal Target Area of the Fermi National Accelerator Laboratory using a gas jet target. A scintillator spectrometer detected the proton recoils. pp elastic cross sections were used for normalization. (Diss. Abstr. Int., B)

Strong (Meson-induced)

Refer also to abstract 33276.

34614 (JINR-E6-8535) EXCITATION OF METASTABLE HIGH SPIN STATES IN NEGATIVE PION CAPTURE BY NUCLEI. Butsev, V. S.; Chultem, D.; Ganzorig, J.; Gavrilov, Yu. K.; Polikanov, S. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 9p. Dep. NTIS (US Sales Only) $4.00.

The production of metastable high spin states in the capture of stopped negative pions by nuclei was discovered. (auth)

34615 DIFFERENTIAL CROSS-SECTIONS FOR $\pi^-p \rightarrow \gamma n$ IN THE FIRST RESONANCE REGION. Guex, L. H.; Joseph, C.; Tran, M. T.; Vaucher, B.; Winkelmann, E.; Bayer, W.; Hilscher, H.; Schmitt, H.; Zupancic, C.; Truoel, P. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 55: No. 1, 101-106(20 Jan 1975).

Differential cross sections for negative pion radiative capture on protons at c.m. angles of 60°, 90°, and 120° have been measured at nine incident laboratory energies between 110 and 270 MeV. Comparison with measured cross sections for pion photoproduction and with conventional multipole analyses shows neither evidence for a violation of time reversal invariance nor for an isotensor component of the electromagnetic current of hadrons. (auth)

34616 STUDY OF THE REACTION $\pi^+p \rightarrow \omega[\rightarrow \pi^0\gamma] + n$ AT 3.8, 6 AND 8 GeV/c. Apel, W. D.; Auslaender, J.; Mueller, H.; Sigurdsson, G.; Staudenmaier, H. M.; Stier, U. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Experimentelle Kernphysik); Bertolucci, E.; Mannelli, I.; Perazzini, G.; Quaglia, M. Phys. Lett., B; 55: No. 1, 111-116(20 Jan 1975).

Results are given for the production differential cross section and the ω decay angular distribution in terms of the ω spin density matrix elements. (auth)

34617 A SPIN-PARITY ANALYSIS OF THE $K^+K^+K^-$ SYSTEM PRODUCED IN THE REACTION $K^+p \rightarrow K^+K^+K^-p$. Carney, J. N.; Colley, D. C.; James, M. F.; Jobes, M.; Jones, G. T.; Kinson, J. B.; Storr, K. M.; Watkins, D. C. (Birmingham Univ. (UK)); Johnson, D. D.; Peeters, P. Phys. Lett., B; 55: No. 1, 117-120(20 Jan 1975).

The first spin-parity analysis of the $(K^+K^+K^-)$ system produced in the reaction $K^+p \rightarrow K^+K^+K^-p$ is presented, and it is shown that the general features of this system resemble those of the $(\pi\pi^+\pi^-)$ and $(K\pi^+\pi^-)$ systems produced in the reactions $\pi(K)p \rightarrow \pi(K)\pi^+\pi^-p$. There is a low mass enhancement, (47 ± 11)% of which corresponds to 1^+ states decaying to Kφ. At higher

$(K^+K^+K^-)$ masses $2^- \rightarrow Kf'$ becomes increasingly significant and at all masses there is a 0^- contribution of roughly 30%. (auth)

34618 A DETERMINATION OF THE SPIN OF THE HYPERNUCLEUS $^{12}_{\Lambda}B$. Kielczewska, D.; Sacton, J. (Inter University Institute for High Energies, ULB-VUB, Brussels); Cantwell, T. (College of Technology, Kevin Street, Dublin); Montwill, A.; Moriarty, P. (University Coll., Dublin (Ireland). Dept. of Physics); Davis, D. H. (University Coll., London (UK). Dept. of Physics); Tymieniecka, T.; Zakrzewski, J. (Warsaw Univ. (Poland). Instytut Fizyki Doswiadczalnej); Juric, M. (Institut za Fiziku, Belgrade (Yugoslavia)); Krecker, U. (Akademie der Wissenschaften der DDR, Berlin). Nucl. Phys., A; 238: No. 3, 437-452(10 Feb 1975).

A study has been made of the decay sequence $^{12}_{\Lambda}B \rightarrow \pi^- + {}^{12}C^* \rightarrow \pi^- + {}^4He + {}^4He + {}^4He$. From a comparison of the measured branching ratios to certain states of ^{12}C and the angular correlations observed in their decays with those predicted by Zieminska and Dalitz, it is concluded that the spin of the hypernucleus $^{12}_{\Lambda}B$ strongly favors the value of unity. (auth)

34619 ANALYSIS OF THE REACTION $K^-p \rightarrow K^-\pi^-\pi^+p$ AT 40 GeV/c. Antipov, Yu. M.; Landsberg, L. G.; Lebedev, A. A.; Yotch, F. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij); Ascoli, G.; Sard, R. D. (Illinois Univ., Urbana (USA)); Busnello, R.; Kienzle-Focacci, M. N.; Lecomte, P.; Martin, M. (Geneva Univ. (Switzerland)). Nucl. Phys., B; 86: No. 3, 381-402(17 Feb 1975).

The reaction $K^-p \rightarrow K^-\pi^-\pi^+p$ has been measured at 25 and 40 GeV/c at the Serpukhov Proton Accelerator. The production cross section at 25 and 40 GeV/c as a function of momentum transfer and $K\pi\pi$ mass is presented, and results of the partial-wave analysis of the $K\pi\pi$ system yielding information about Q(1300), K^*(1400) and L(1770) mesons are discussed. (auth)

34620 ENERGY DEPENDENT PARTIAL-WAVE ANALYSIS OF $K^-p \rightarrow \Lambda\pi^0$ BETWEEN 1540 AND 2215 MeV. Van Horn, A. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., B; 87: No. 1, 145-156(24 Feb 1975).

An energy-dependent partial-wave analysis of $K^-p \rightarrow \Lambda\pi^0$ has been performed over the energy range 1537 to 2215 MeV, using the world data sample for $d\sigma/d\Omega$ and $(d\psi/d\Omega)$ P in the form of Legendre polynomial coefficients. Improved parameters for the F15(1920) resonance have been obtained: $E_R = 1920$ MeV, $\Gamma = 102$ MeV, $t = -0.09$. In addition to the established D13(1660), D15(1765), and F17(2040) states, resonance parameters are given for possible Σ resonances in S11(1700), D13(1950), P11(1670), S11(2000), F15(2250), P11(1985) and P13(1925). Details of the analysis are presented and tentative SU(3) assignments are discussed. A further paper will discuss the uniqueness of these solutions. (auth)

34621 STUDY OF NEUTRON DIFFRACTION DISSOCIATION IN THE REACTION $\pi^-n \rightarrow \pi^-\pi^-p$ AT 9 GeV/c. Rivoal, M.; Durusoy, N. B.; George, R.; Goldberg, M.; Touchard, A. M. (Paris-6 Univ., 75 (France). Lab. de Physique Nucleaire et de Hautes Energies); Armenise, N.; Fogli-Muciaccia, M. T.; Silvestri, A. (Bari Univ. (Italy). Istituto de Fisica). Nucl. Phys., B; 87: No. 1, 61-73(24 Feb 1975).

In the reaction $\pi^-d \rightarrow \pi^-\pi^-pp_s$ at 9 GeV/c the $p\pi^-$ mass spectrum beyond a broad enhancement near the threshold, a production of N^* 1520 and N^* 1690. The production mechanism is studied and the difference in $d\sigma/dt$ between the threshold enhancement and the isobars seems to be well accounted by the variation of the slope versus mass. (auth)

34622 K^+ NUCLEON ELASTIC SCATTERING AT 180° BETWEEN 1.0 AND 1.5 GeV/c INCIDENT MOMENTUM. Adams, U.; Carter, R. S.; Cook, V.; Glass, G.; Green, K. (Washington Univ., Seattle (USA). Dept. of Physics). Nucl. Phys., B; 87: No. 1, 41-51 (24 Feb 1975).

The cross section at 180° has been measured for K^+p and K^+n elastic scattering in the momentum range 1.0 to 1.5 GeV/c. The K^+n cross section was measured on deuterium and the K^+p on hydrogen and deuterium. The difference between free nucleon (proton) scattering and bound nucleon (proton) scattering at large angles was thus measured. This difference was found to be small and within the experimental accuracy the K^+p(n) cross section should be equal to the K^+p (free) cross section at 180°. No evidence was found for an s-channel resonance Z^* in either the K^+p or K^+n system. A comparison of the data and those of other groups with theoretical predictions is given. (auth)

34623 MULTIPLICITY DISTRIBUTIONS OF NEUTRAL PARTICLES IN π^-–N INTERACTIONS AT THE MOMENTUM p = 40 GeV/c. Abesalashvili, L. N.; Amaglobeli, N. S.; Gersamiya, D. V. (Tbilisi State Univ., USSR). Soobshch. Akad. Nauk Gruz. SSR; 77: No. 1, 45-48(Jan 1975). (In Russian).

Multiplicity distributions of neutral particles, γ quanta, Λ hyperons and K^o mesons are given. Dependence of the average number of γ quanta on the multiplicity of charged particles is observable. (auth)

34624 INFORMATION FROM COHERENT PRODUCTION ON DEUTERIUM. Lesniak, L.; Zalewski, K. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol.; B6: No. 1, 69-78(1975).

Possibilities of obtaining information from the coherent production process $\pi d \rightarrow (3\pi)d$ about the diffractive dissociation process on nucleons $\pi N \rightarrow (3\pi)N$ and the $(3\pi)-N$ elastic scattering are studied. (auth)

34625 PARAMETRIZATION OF THE MISSING MASS DISTRIBUTION IN AN INCLUSIVE PROCESS. Eskreys, A. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol.; B6: No. 1, 79-85 (1975).

A parametrization of the missing mass distribution in an inclusive process $a + b \rightarrow c + X$ is proposed in terms of the variable $\xi = (M/\sqrt{s} - m_c)$ (m_c being the mass of the inclusive particle c). On the basis of $K^+ + p \rightarrow K^0 + X$, $K^+ + p \rightarrow \pi^+ + (K^0 + X)$, $K^+ + p \rightarrow \pi^- + (K^0 + X)$ data at 5 and 8.2 GeV/c, it is found that the distribution $[(1/\langle n_c \rangle)\ (d\sigma/d\xi)]$ scales better than the Feynman invariant cross-section and has a simple exponential form. (auth)

Particle Interactions and Properties (Theoretical)

General

34626 (ANL/HEP-75-02, pp XXVII.1-XXVII.18) ANALYSIS OF POLARIZATION MEASUREMENTS AND TEST OF SELECTION RULES AND OF MODELS. Michel, L. (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

The following topics are discussed: The polarization domain; angular momentum conservation; incomplete observations; parity conservation; spin 1; spin $\frac{1}{2}$; test of models by polarization measurements; and internal symmetries. (LBS)

34627 (JINR-E2-8540) INVESTIGATION OF POLARON MODEL BY FUNCTIONAL INTEGRATION METHOD. Kochetov, E. A.; Kuleshov, S. P.; Smondyrev, M. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 13p. Dep. NTIS (US Sales Only) $4.00.

A consistent rigorous scheme is proposed for calculation of the polaron effective mass. The scheme rests on the Bogolubov canonical transformations and approximate continual integration. (auth)

34628 (JINR-P2-8512) INTERFERENCE OF TWO-PARTICLE STATES IN PARTICLE PHYSICS AND ASTRONOMY. Kopylov, G. I.; Podgoretskii, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

There can be two kinds of observation of the two-particle state interference. One can measure the difference between the moments of arrival of two like particles at detectors and the difference between their coordinates. This is the space-time experiment (I) used in astronomy. Instead of it, one can measure the differences between the energies of like particles and also between their momenta. This energy-momentum experiment (II) can be used in particle physics. Both can give the space parameters (dimensions) of the region in which the particles are produced: star in I and excited multiple production volume in II. But the time parameters obtained in I and II do not coincide. This difference is analyzed, and it is shown that it appears due to different phase expressions. The probability of the effect is found for I and II. At the end an experiment is proposed which in one limit comes into I and in the opposite case into II. (auth)

34629 (P-7975) ANNUAL REPORT, 1973. (Joint Inst. for Nuclear Research, Dubna (USSR)). 9 Jul 1974. 164p. (In Russian). Dep. NTIS (U. S. Sales Only) $11.25.

The problems to be studied and the results obtained in the areas of theoretical physics, high energy physics, nuclear physics, nuclear reactions, neutron physics, data processing and automation, new methods of acceleration are briefly indicated. The consultation work and international relations of the Institute are reviewed. The operation of the data libraries is discussed. Radiation safety is briefly considered. (JSR)

34630 PRESENCE OF A PARTICLE IN A GIVEN SPACE–TIME REGION AND THE CONTINUOUS ACTION OF A PARTICLE DETECTOR. Bloch, I.; Burba, D. A. (Vanderbilt Univ., Nashville). Phys. Rev., D; 10: No. 10, 3206-3218(15 Nov 1974).

An attempt is made to answer several questions relating to the presence of a particle, with known initial state, in a given region of space during a given period of time. In the process, an attempt to

extend the quantum theory of observation to the case in which the observation goes on continuously is tried. Although this mode of observation is common in practice, the theory does not seem to describe it adequately. In general, questions like those that one is asking do not have simple, unambiguous answers in quantum theory. In order to approach such a question, one usually must assume that the particle interacts with something in the space-time region of interest, and then infer the probability of the particle's presence from the probability of its interacting with the other object. This fact suggests either that one is asking the wrong questions or that perhaps quantum mechanics should be regarded as a theory of interaction events rather than a theory of systems. (auth)

34631 ESTIMATE OF THE INITIAL VOLUME AND MULTIPLICITY IN THE STATISTICAL THEORY OF MULTIPLE PRODUCTION AT HIGH ENERGIES. Ioffe, B. L. (Inst. of Theoretical and Experimental Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 20: No. 6, 162-163(20 Sep 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 20: No. 6, 360-362(20 Sep 1974).

Starting from estimates of the effective longitudinal distances in deep-inelastic electroproduction processes and in hadron collisions, energy dependences of the initial volume and of the multiplicity, other than those usually assumed, are obtained in the hydrodynamic Landau theory. (auth)

34632 PARTICLE INTERACTIONS AT VERY HIGH ENERGIES. Part B. Conference Held in Louvain, Belgium, August 12–25, 1973. Speiser, D.; Halzen, F.; Weyers, J. (eds.). NATO Advanced Study Institutes Series. New York; Plenum Publishing Corporation (1974). 378p. (CONF-730863-PB). $25.00.

Separate abstracts were prepared for the six papers presented. (JFP)

For abstracts of individual papers see: 34585, 34633, 34649, 34679, 34725, and 35086.

34633 PERMANENTLY BOUND QUARKS. Mandula, J. E. (Massachusetts Inst. of Tech., Cambridge). pp 131-176 of Particle Interactions at Very High Energies. Part B. Speiser, D. (ed.). New York; Plenum Publishing Corp. (1974).

From 2nd summer institute on particle interactions at very high energies; Louvain, Belgium (12 Aug 1973). See CONF-730863-PB.

Lectures are given on the problems of putting the constituent quark picture into a field theoretic framework and the problem of arranging the dynamics in a quantum theory of quark field so that when bound states of quarks (hadrons) interact, these interactions never produce free quarks. (JFP)

34634 EKSPERIMENTAL'NAYA YADERNAYA FIZIKA. Tom II. Fizikia Elementarnykh Chastits. (Experimental Nuclear Physics. Volume II. Physics of Elementary Particles). Mukhin, K. N. Moscow; Atomizdat (1974). 336p.

A description is given of the properties of elementary particles and the interactions in which they participate (strong, electromagnetic and weak). Consideration is given to nucleon-nucleon interactions at various energies, nuclear forces, theory of the deuteron, structure of nucleons, the properties of leptons, mesons, hyperons and resonances, the physics of antiparticles and unitary symmetry. Attention is devoted to experiments on elastic and inelastic scattering of electrons on nuclei and nucleons, and the problem of nucleon form factors is discussed. A detailed presentation is given of the physics of leptons, π-mesons and strange particles. The physics of antinucleons and other antiparticles is considered. (SJR)

34635 EVOLUTION OF ELEMENTARY PARTICLES AND COSMIC SPECTRAL SHIFT. Hsueh, P. Y. (Inst. of Atomic Energy, Peking). K'o Hsueh T'ung Pao; 19: No. 10, 463-466 (15 Oct 1974).

Five points on the evolution of elementary particles and the cosmic spectral shifts are discussed to dispute an article by T'ang Hsiao-wei (0781/1321/1218) on the subject, originally published in Vol 19, No 5, p 215 of this journal. The points discussed include the conservation mass in the evolution of elementary particles, and a more specific interpretation of the formula expressing the evolution of the elementary particles and their influences on cosmic spectral shifts. (auth)

34636 SPIN OF LEADING CLUSTERS AND SLOPE OF THE OVERLAP FUNCTION. Bialas, A. (Uniwersytet Jagiellonski, Krakow (Poland). Instytut Fizyki); Sakai, N. (See Code-5677710 Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Phys. Lett., B; 55: No. 1, 81-83(20 Jan 1975).

It is pointed out that the spin structure of leading clusters appearing in the final state of inelastic collisions at high energies influences strongly the estimate of the slope of the overlap function. It is also argued that this effect may drastically improve the agreement with experimental data. (auth)

34637 AZIMUTHAL CORRELATIONS IN P- OR Q-FACTORIZED CLUSTER PRODUCTION. Meunier, J. L.; Plaut, G. (Nice Univ., 06 (France). Lab. de Physique Theorique). Nucl. Phys., B; 87: No. 1, 74-84(24 Feb 1975).

The study of the mean value $\langle p_{\perp 1} \cdot p_{\perp 2} \rangle (\gamma_1, \gamma_2)$ in P- or Q-factorized cluster production indicates the presence of mean range azimuthal correlations in multiperipheral (Q-factorized) cluster production, and gives test for the size of the mean transverse momentum of the clusters. (auth)

34638 PROBABILITY INTERPRETATION PROBLEM OF SOLUBLE MODELS WITH COMPLEX ELEMENTARY PARTICLE MASSES. Keszthelyi, T.; Nagy, K. L. (Roland Eotvos Univ., Budapest). Acta Phys. Acad. Sci. Hung.; 37: No. 3, 259-273 (1974).

After an appropriate extension of the usual definition of the transition probability exactly soluble models are given showing the physical unitarity in this new form. Limits of $M \to$ real are investigated. (auth)

34639 DIFFRACTIONAL NUCLEAR PROCESSES INVOLVING COMPOSITE PARTICLES. Sitenko, A. G. (Inst. of Theoretical Physics, Kiev). Fortschr. Phys.; 22: No. 8, 453-479(1974).

The diffractional picture of nuclear processes at high energies involving composite particles is given. The solution of the Lippmann–Schwinger equation for the problem on scattering in the scattering center systems is considered in the high energy approximation. The general formulas for the cross section of different diffractional processes with particle transmission are obtained. The effects of multiple scattering and their mutual compensation are discussed. The applicability conditions of the diffractional approach are discussed. The diffractional processes during the interaction of high energy deuterons with nuclei are considered in detail. Without the assumption of deuteron size smallness compared to nuclear size, the cross sections of different diffractional processes are calculated with nuclear boundary diffusion taken into account. The nonmonotonic dependence of the diffractional disintegration cross section for deuterons on the mass number is shown due to the influence of nuclear boundary diffusion. The role of the diffractional and the Coulomb mechanisms of interaction depending on the nuclear mass number is discussed. The calculated dependences are compared with experimental data. The interference during the multiple scattering and its relation with the diffractional structure of the angular scattering during the scattering on the composite systems are considered. The comparison between the diffractional approximation and different variations of the impulse approximation is made. (auth)

34640 MULTIPERIPHERAL MODEL WITH CONTINUED CROSS CHANNEL UNITARITY. Jackson, S. A. (National Accelerator Lab., Batavia, IL). Ann. Phys. (N. Y.); 89: No. 1, 149-167(Jan 1975).

One derives, by using a spectral representation in momentum transfer, t, an integral equation, similar in structure to a multiperipheral equation, with continued cross channel unitarity, for the absorptive part for a composite particle scattering amplitude from a Bethe-Salpeter equation describing composite particle scattering in the s channel. At high energy in the t channel, the equation becomes homogeneous and has a Reggeized solution. It is indicated how this equation may be solved using determinental techniques. It is also shown how the composite particle amplitude resulting from the original equation may be used to construct production and three body amplitudes. The possibility of studying, using the amplitude from the cross channel problem, the effect of extra unitarity on Reggeon–Reggeon–particle vertices is also inferred. (auth)

34641 TWO OR EIGHT GLUONS. Krolikowski, W. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 22: No. 11, 1169-1172(1974).

A Yukawa coupling of colored quarks with two vector gluons is considered and reasonable first-order static forces for quark systems provided. This coupling can be embedded into the well known Yang–Mills scheme with eight colored vector gluons, which gives first-order static forces supporting the "symmetric quark model." (auth)

Electromagnetic

Refer also to abstract 35090.

34642 (ANL/HEP-75-02, pp XXXII.1-XXXII.14) HISTORICAL PERSPECTIVE OF SPIN. Dirac, P. A. M. (Florida State Univ., Tallahassee). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

A discussion is given of the ideas and observations that led to the development of the theory of electron spin. (LBS)

34643 (DESY-74/42) DO RECENT e^+e^- ANNIHILATION DATA IMPLY VIOLATIONS OF SCALING IN DEEP INELASTIC ELECTRON SCATTERING. Iwai, S.; Schildknecht, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Sep 1974. 9p. INIS.

It is conjectured that there is breaking of scaling in the large ω region in deep inelastic scattering as a reflection of the approximate constancy of sigma(e^+e^- → hadrons) observed from about 3.5 to 5 GeV c.m. energy. (auth)

34644 (IPNO-T-74-11) ASYMPTOTIC PROPERTIES OF VARIOUS PROCESSES AS A RESULT OF THE LIGHT CONE BEHAVIOR OF THE CURRENT COMMUTATORS. Georgelin, Y. (Paris-11 Univ., 91 – Orsay (France). Div. de Physique Theorique; Paris-6 Univ., 75 (France)). 1974. 79p. (In French). INIS.

The study of the reaction e + p → e + N, where e stands for the initial electron, p, for the proton target, and N, for all allowed final states, shows that at high energy and high momentum transfer the form factor on a rather extended region depends only on the ratio $\xi = q^2/2(pq)$, where q stands for the momentum transfer between leptons and hadrons (Bjorken scaling law). Such a behavior remains completely unexpected on the grounds of perturbative quantum electrodynamics, the first powers in the series showing a logarithmic violation of the scaling law. A phenomenological explanation is proposed: the light-like restriction of current commutators. The model as formulated by Leutwyler and Stern in the case of the deep inelastic electroproduction has been extended in two directions; first of all, to processes with a finite number of final hadrons (deep inelastic scattering of polarized electrons with polarized protons; the $\gamma\pi^0\gamma$ vertex where one photon is far from its mass shell in the $e^+ + e^-$ → $\pi^0\gamma$ colliding beam reaction and the asymptotic behavior of the various form factors of lepton pair photoproduction on zero-spin targets) and, secondly, to the deep inelastic neutrino production which can be studied in the Bjorken limit. Some formal studies on the existence of light-like restrictions of commutators which actually have some observable consequences have been induced. (FR)

34645 PASSAGE OF γ PULSES THROUGH A RESONANCE MEDIUM. Mitin, A. V. (Kazan Physical-Tech. Inst.). Dokl. Akad. Nauk SSSR; 217: No. 6, 2184-2186(21 Aug 1974). (In Russian).

An expression for the resonance intensity of γ radiation passing through a Moessbauer medium is derived. (JSR)

34646 ASYMMETRY OF ANGULAR DISTRIBUTION IN THE REACTION $\gamma + d \rightarrow \pi^0 + d$ WITH LINEAR POLARIZED γ-QUANTA. Gakh, G. I. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 11, 1914-1916(Nov 1974). (In Russian).

The angular and energy dependences of the asymmetry of the angular distribution of π^0 mesons in $\gamma d \rightarrow \pi^0 d$ reactions (with consideration of only the S waves of the deuterons) at photon energies from 200 to 750 MeV were studied in the impulse approximation. The results of the multipole analyses of Pfeil and Schwela were used in the calculations. (tr-auth)

34647 ELECTRON–PHOTON SHOWER DEVELOPMENT IN A FOLIATED MEDIUM WITH A RANDOM DENSITY. Uchaikin, V. V.; Ryzhov, V. V. (Altai State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 16-21(1974). (In Russian).

The development of electron-photon showers in a medium with random density was examined. Formulas were obtained which express the characteristics of the shower, averaged across the medium fluctuations, by correlating the shower characteristics with a given density. Numerical calculations were made of atmospheric showers. (tr-auth)

34648 FUSION OF TWO PHOTONS INTO ONE ON AN ELECTRON. Smirnov, A. I. (Kostroma State Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 132-133(1974). (In Russian).

The probability for the fusion of two photons into one on an electron is calculated for nonpolarized particles. (JSR)

34649 DEEP INELASTIC SCATTERING AND FINAL STATE HADRONS. Gilman, F. J. (Stanford Univ., CA). pp 1-42 of Particle Interactions at Very High Energies. Part B. Speiser, D. (ed.). New York; Plenum Publishing Corp. (1974).

From 2nd summer institute on particle interactions at very high energies; Louvain, Belgium (12 Aug 1973). See CONF-730863–PB.

Lectures are given on a review of what is expected from the quark light cone algebra or its concrete realization in terms of the quark parton model for the behavior of deep inelastic electron–nucleon, neutrino–nucleon, and antineutrino–nucleon scattering and for electron–positron annihilation into hadrons. Experimental data are compared with theoretical expectations and found to form a very simple consistent picture with the possible exception of the results for $\sigma(e^+e^-$ → hadrons). Also some salient pieces of experimental information that were collected so far on the final hadron in inelastic electron scattering, and some theoretical ideas which were expressed on this subject and their classification in the framework of a general analysis the regions of rapidity possible for the final hadrons are considered. (JFP)

34650 SUM RULE FOR PION PHOTOPRODUCTION FROM THE PION SOURCE ALGEBRA. Khare, A. (Tokyo Univ. (Japan)). Progr. Theor. Phys. (Kyoto); 51: No. 5, 1513-1520(May 1974).

Assuming that the space integrals of source terms in the Klein–Gordon equation for the pion fields together with isospin generators form an SU(2) ⊕ SU(2) algebra, a sum rule is derived for the pion photoproduction amplitude. (auth)

34651 MESON EXCHANGE AND ISOBAR ADMIXTURE CONTRIBUTIONS TO ELASTIC ELECTRON–DEUTERON SCATTERING. Fabian, W.; Arenhoevel, H. (Mainz Univ. (F. R. Germany). Inst. fuer Kernphysik); Miller, H. G. (Frankfurt Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Z. Phys.; 271: No. 2, 93-96(Dec 1974).

The deuteron structure functions for elastic electron scattering and the deuteron static properties have been calculated with the inclusion of isobar admixtures to the deuteron wave function and meson exchange currents. At higher momentum transfers the structure functions are increased significantly because of the strong enhancement of the deuteron magnetic dipole form factor. Roughly 15–35% of this enhancement depending on the momentum transfer arise from the meson exchange currents. (auth)

34652 COULOMB EFFECT ON THE PROTON–PROTON LOW ENERGY SCATTERING PARAMETERS. Kermode, M. W.; Nogami, Y.; Van Dijk, W. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 53: No. 3, 207-209(1 Feb 1975).

The effect of the Coulomb force on low energy proton–proton scattering is examined when the nuclear interaction is represented by a rank one separable potential of Tabakin's type. The scattering length which is obtained by switching off the Coulomb force is found to be –20.0 F. This value is appreciably different from those for local realistic potentials. This anomaly is similar to the one which was recently found by Sauer. (auth)

34653 DOES THE PROPER MASS OF ELECTRONS CHANGE WITH TIME? Fang, L. C. K'o Hsueh T'ung Pao; 19: No. 10, 466-468(15 Nov 1974).

A dispute is presented, on the basis of some astronomical observations and analysis on whether proper mass of electrons changes with time, with work by T'ang Hsiao-wei (0781/1321/1218) on the subject, originally published in Vol 19, No 5, p 215 (1974) of this journal. It is shown that the formula expressing the increase of the proper mass of electrons cannot express the cosmic spectral shift completely, and that modern observations tend to discard the two formulas proposed by T'ang on the increase of the proper mass of electrons and nuclii. (auth)

34654 PION EXCHANGE CURRENTS IN ELASTIC ELECTRON DEUTERON SCATTERING. Jackson, A. D. (State Univ. of New York, Stony Brook (USA). Dept. of Physics); Lande, A. (Rijksuniversiteit Groningen (Netherlands). Instituut voor Theoretische Natuurkunde); Riska, D. O. (Michigan State Univ., East Lansing (USA). Dept. of Physics). Phys. Lett., B; 55: No. 1, 23-27(20 Jan 1975).

The effects of pion-exchange pair and recoil currents on the electromagnetic form factors of the deuteron are calculated. Both exchange currents give significant contributions to the charge form factor and, despite some cancellation, their net effect is appreciable for $q^2 \geq 10$ fm^{-2}. (auth)

34655 DIFFERENTIAL CROSS SECTION OF $e^+ + e^- \rightarrow e^+ + \mu^- + \nu_\mu + \nu_e$. Cung, V. K. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). Phys. Lett., B; 55: No. 1, 67-70 (20 Jan 1975).

The differential cross section of the reaction $e^+ + e^- \rightarrow e^+ + \mu^- + \nu_\mu + \nu_e$ is calculated to the lowest order in electromagnetic and weak interactions. The effective total cross section at 20 GeV center of mass energy is 0.38×10^{-40} cm^2. (auth)

34656 SYSTEM OF EXACT EQUATIONS FOR UNITARY AND BINARY FUNCTIONS OF THE CHARGED PARTICLE ASSEMBLY DISTRIBUTION. Martynov, G. A. (Inst. of Earth Physics, Moscow). Dokl. Akad. Nauk SSSR; 218: No. 5, 1064-1067(11 Oct 1974). (In Russian).

On the basis of the Bogolyubov equation for the equilibrium distribution function a system of exact equations are derived for distribution functions of an assembly of charged particles. (JSR)

34657 DYNAMICS OF A PARTICLE IN A PERIODIC POTENTIAL SUBJECT TO A UNIFORM ELECTRIC FIELD. Weissman, Y. (Soreq Nuclear Research Centre, Yavne, Israel). Collect. Phenomena; 2: No. 1, 23-28(Jan 1975).

The effect of a uniform electric field on the space-time-dependent behavior of a Wannier wave packet is studied in detail. By expanding the Wannier wave packet in the single band time-dependent eigenfunctions of the system, one can show that the mean position ⟨R⟩ of the wave packet under normal conditions is time-independent even in the presence of a uniform electric field. The application of the uniform electric field, however, imposes on the Wannier wave packet a periodic time dependence in the direction of the field. This feature is reflected in the expectation value of R^2 calculated for the time-dependent wave packet. (auth)

34658 SOME FEATURES OF THE RADIATION FROM SOURCES MOVING IN REFRACTING MEDIA. Barsukov, K. A.; Gvozdev, V. A. Zh. Eksp. Teor. Fiz.; 68: No. 2, 447-451(Feb 1975). (In Russian).

Some peculiarities of observation of the radiation emitted by a source moving in a medium with a velocity exceeding that of light are considered. It is shown that a certain critical angle exists at which the first flash of the source can be observed. For isotropic or anisotropic media without dispersion the angle is identical to the Vavilov–Cherenkov emission angle. The normal and anomalous parts of the radiation in the Doppler effect appear to the observer as emitted by two sources moving in opposite directions. The specificity of observing the Vavilov–Cherenkov effect in dispersive media is also discussed. (auth)

34659 CALCULATION OF THE EFFECTIVE ELECTRON MASS IN A PERIODIC FIELD NEAR THE BAND BOUNDARY. Firsov, O. B. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 68: No. 2, 568-576(Feb 1975). (In Russian).

It is proven that at the extrema of energy as a function of wave vector k the integral of the current density over any cross section of the unit cell is zero, providing the wave vector does not lie in the nodes or in the middle between nodes of the reciprocal lattice. A method for calculating the effective mass near the band boundary is presented. In contrast to the familiar perturbation theory method in the second order with respect to $k-k_0$ which requires the determination of all eigenfunctions and eigenvalues of the energy at $k=k_0$, it is proposed that only a single eigenvalue equation for the boundary of the given band be solved. Moreover, it is necessary to solve an inhomogeneous equation for which a particular solution is indicated and this considerably simplifies the problem. The effective mass can be expressed only in terms of an integral of the wave functions. In the Wigner–Seitz approximation the problem reduces to the solution of two or three second order ordinary linear homogeneous differential equations. The eigenvalue has to be determined for only one of the equations. In the one-dimensional case the eigenvalue problem must be solved for a single ordinary differential equation; in other words only one wave function, in terms of which the effective mass can be expressed by a simple formula, needs to be known. The method is illustrated by a calculation of the effective mass of compressed hydrogen in the Wigner–Seitz approximation. In the one-dimensional case a quasiclassical expression is obtained for the effective mass and band width in terms of the quasiclassical momentum in the classically inaccessible region. (auth)

34660 BHABHA EQUATIONS FOR UNIQUE MASS AND SPIN. Santhanam, T. S.; Tekumalla, A. R. (Inst. of Mathematical Sciences, Madras). Fortschr. Phys.; 22: No. 8, 431-452(1974).

Linear relativistic wave equations of Bhabha's type are discussed. Conditions for unique mass and unique spin are analyzed in detail. It is shown that if one relaxes the diagonalizability of β_5 by a weaker block form one gets a class of equations describing a spin-half particle. Several algebras which emerge and their representations are studied. The existence or otherwise of the hermitian matrix in such cases is explicitly discussed. The properties of the new equations in the presence of minimally coupled electromagnetic field are discussed. (auth)

34661 MOTION OF A CHARGED PARTICLE UNDER THE ACTION OF A STRONG ELECTROMAGNETIC PLANE WAVE. Gernet, G. E. Vestn. Leningrad. Univ., Fiz., Khim.; 22: No. 4, 65-73(Nov 1974). (In Russian).

The motion of a particle under the action of a strong circularly polarized electromagnetic plane wave is considered, the radiation reaction being taken into account. The frequency and the amplitude of the wave considered are typical for pulsars. (auth)

34662 COMPTON–GETTING EFFECT OF LOW ENERGY PARTICLES. Ipavich, F. M. (Univ. of Maryland, College Park). Geophys. Res. Lett.; 1: 149-152(Aug 1974).

The traditional first-order Compton–Getting effect, which relates particle distributions as observed in two frames of reference moving with constant relative velocity, is inadequate for the description of low energy particles (less than a few hundred keV/nucleon) in the solar system. An exact procedure is given for recovering both isotropic and anisotropic distributions in the solar wind frame from observations made in a spacecraft frame. The method is illustrated by analyzing a particle event observed by an experiment on IMP-7 on Oct. 31, 1972. (auth)

34663 J = 0 SINGULARITY IN FORWARD VIRTUAL COMPTON AMPLITUDE. Sakuraoka, M. (Nippon Dental Coll., Tokyo). Progr. Theor. Phys. (Kyoto); 51: No. 5, 1496-1502(May 1974).

In the approximation that $R = \sigma_L/\sigma_T$ is a function only of the virtual photon mass squared q^2, one writes down the ν-variable dispersion relation for $T_1(\nu,q^2)$. One investigates phenomenologically the contribution of J = 0 singularity to the FESR assuming that the Pomeron and the Regge poles (f^0, A_2^0) are expressed by scaling functions except for a region near the photoabsorption threshold. The argument indicates a residue of J = 0 singularity $C(q^2) \propto [-q^2/\alpha^2-q^2]^{\alpha_1(0)}$ + [Born contribution]. Thus the residue of J = 0 singularity is not polynomial in q^2 and C(0) is smoothly continued to the deep inelastic electroproduction region. (auth)

34664 DIFFRACTION AND INTERFERENCE OF ELECTRONS. Komrska, J. (CSAV, Brno). Cesk. Cas. Fys.; 25: No. 1, 1-13 (1975). (In Czech).

The review deals with the history of experiments that verified the wave nature of particles, especially of electrons. First, the diffraction of electrons and other particles by crystal lattices and ruled gratings is described. Further several interesting examples of Fresnel diffraction phenomena produced by electrons are presented. Finally, the electron interference experiments both with divided amplitude and divided wave front are described, and their applications enumerated. (auth)

34665 PROPER TIME FORMULATION OF DIRAC THEORY WITH ELECTROMAGNETIC INTERACTIONS. Chang, K. K. Columbia, SC; Univ. of South Carolina (1974). 80p. University Microfilms Order No. 75-8659.

Thesis (Ph. D.).

A proper-time quantum theory for spin ½ particles in an arbitrary external electromagnetic field is proposed which exhibits manifest covariance and which explicitly exhibits the correspondence to the classical dynamical equations including spin. The diagonalization of the Hamiltonian with arbitrary interactions present is achieved thus generalizing the work by Foldy and Wouthuysen. Classical correspondence is studied both for the Dirac operators and for the dynamical equations. (Diss. Abstr. Int., B)

Weak

34666 THE HYPERNUCLEUS $^{12}_{\Lambda}$B AND THE DECAY PROCESS $^{12}_{\Lambda}\mathrm{B} \to \pi^- + 3\alpha$. Zieminska, D.; Dalitz, R. H. (Oxford Univ. (UK). Dept. of Theoretical Physics). Nucl. Phys., A; 238: No. 3, 453-490(10 Feb 1975).

The characteristics of the decay sequences $^{12}_{\Lambda}\mathrm{B} \to \pi^- + {}^{12}\mathrm{C}^*$, $^{12}\mathrm{C}^* \to 3\alpha$ are discussed for the two sharp levels of $^{12}\mathrm{C}^*$ at excitation energies of 12.7 MeV ($J_f = 1^+$, T = 0) and 16.11 MeV ($J_f = 2^+$, T = 1), which are observed prominently in this decay process. The transition rates for these processes and the angular correlations in the final four-particle state $\alpha\alpha\alpha\pi^-$ are discussed quantitatively, by using the intermediate coupling model for both the $^{12}_{\Lambda}$B and $^{12}\mathrm{C}^*$ systems, as a function of the $^{12}_{\Lambda}$B spin J. Three distinct tests are proposed, which are sensitive to the spin J for ground-state $^{12}_{\Lambda}$B, and which have been used by the European K^- Collaboration to deduce that J = 1 for $^{12}_{\Lambda}$B. The implications of this conclusion for the ΛN and ΛNN interactions are briefly discussed. (auth)

34667 IMPLICATIONS OF GAUGE THEORIES FOR HEAVY LEPTONS. Albright, C. H.; Jarlskog, C. (European Organization for Nuclear Research, Geneva (Switzerland)); Tjia, M. O. (International Centre for Theoretical Physics, Trieste (Italy)). Nucl. Phys., B; 86: No. 3, 535-547(17 Feb 1975).

General features of heavy lepton production and decay are studied in the framework of a large number of gauge models. A convenient classification into SU(2) type and SU(3) type models is made according to the leptonic multiplets and allowed transitions. Striking differences are expected for the production and decay mechanisms of the two types of models. Associated strange particle production and the decay branching ratios should serve as helpful guidelines in searching for the correct gauge model. (auth)

34668 NEUTRINO STATISTICS: ELEMENTARY PROBLEMS AND SOME APPLICATIONS. Kuchowicz, B. (Univ., Warsaw). Fortschr. Phys.; 22: No. 9, 525-537(1974).

A brief review of various aspects of neutrino statistics is given.

First there is given a list of relevant formulas for the cases of weak and strong degeneracy of a neutrino gas, then ways of deriving more accurate expressions are indicated. Applications to stellar interiors and to cosmology are outlined. Some unsolved problems are listed. (auth)

34669 THEORY OF WEAK INTERACTION WITHOUT DIVERGENCIES. Tran huu Phat. (Hanoi Univ., Vietnam). Acta Phys. Acad. Sci. Hung.; 37: No. 3, 207-218(1974).

Based on the existence of a cosmic field suggested by previous work, a theory of a weak interaction without divergencies was set up. The current-current theory of Gell-Mann and Feynman is applied in combination with the theory of nonpolynomial interaction. It is proved that all terms of perturbation theory series are convergent. Some interesting terms of second order are considered in detail. (auth)

34670 STRUCTURE OF THE DUFFIN-KEMMER-PETIAU MATRIX ELEMENT FOR K_{l3} DECAY. Fischbach, E. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Physics); Nieto, M. M.; Scott, C. K. Progr. Theor. Phys. (Kyoto); 51: No. 5, 1585-1597 (May 1974).

The most general form of the K_{l3} current matrix element in the Duffin-Kemmer-Petiau (DKP) formalism is deduced. This is done by two methods: An explicit evaluation of the DKP covariants and by using only Lorentz invariance and the fact that the incoming and outgoing meson states are solutions of the DKP equation. The formal reduction of the matrix element is facilitated by introducing particular properties of the spin-0 algebra and fully exploiting the DKP consequent equation. One emphasizes that there are only two independent DKP K_{l3} vector form factors, (b) there is only one independent DKP scalar form factor and (c) in, for example, the DKP K^*-pole model, there must exist a zero in the DKP current-divergence matrix element. (auth)

34671 ON SELECTION RULE OF WEAK PROCESSES AND DECAYS OF NEW PARTICLES. II. Hayashi, T.; Ogawa, S. (Hiroshima Univ. (Japan). Dept. of Physics); Nakagawa, M.; Nitto, H. Progr. Theor. Phys. (Kyoto); 52: No. 2, 636-646(Aug 1974).

Selection rules are proposed for weak processes. The first rule is $\Delta n_t = 0$, where $n_t = n + \bar{n}$; $n(\bar{n})$ indicates an (anti-)urbaryon number. The second rule is that a dimensionality of the SU(3) representation of hadronic system is conserved along s- or t-channel depending on the parity property. These rules are applied to decay processes of new hadrons, an indication of which was observed in a cosmic ray jet. Some conjectures are further attempted on the second event that has recently been reported. (auth)

34672 AN ANALYSIS OF SCALING IN TERMS OF PARTON DENSITY DISTRIBUTIONS. Akama, K. (Tokyo Univ. (Japan). Coll. of General Education). Progr. Theor. Phys. (Kyoto); 51: No. 6, 1879-1892(Jun 1974).

A possible role of parton density distributions is studied in the description of deep inelastic lepton-nucleon scattering. The ideal case is considered in which parton densities can be defined in an invariant manner under Lorentz transformations. The structure functions of inelastic lepton nucleon scattering $W_i(\nu, q^2)$ in the nondeep inelastic region are then expressed in terms of their scaling limit functions $F_i(x)$ under a certain assumption. (auth)

34673 ANOMALIES, SHORT-DISTANCE BEHAVIOR AND RADIATIVE CORRECTION TO $\pi^- \to l^- \bar{\nu}$. Nakazawa, N.; Shimada, T.; Yamada, M. (Tokyo Univ. (Japan). Dept. of Physics). Progr. Theor. Phys. (Kyoto); 51: No. 6, 1932-1946(Jun 1974).

Consequences of various anomalies are investigated in connection with the radiative correction to $\pi^- \to l^- \bar{\nu}$ decay. A divergence remains in the contribution of the weak vector current irrespective of any structure of π-mesons, and it is related to the q-number anomaly in equal time commutators of currents. On the other hand, neither the Ward identity anomaly nor the commutator anomaly is relevant to the contribution of the weak axial-vector current. The existence of divergence in this case depends on the models of strong interactions. It is shown that there are pretty natural conditions under which the contribution is even finite. (auth)

Strong (General)

Refer also to abstract 34984.

34674 (ANL/HEP-75-02, pp I.1-I.37) POLARIZATION EFFECTS IN QUASI-TWO-BODY REACTIONS. Donohue, J. T. 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22-26, 1974.

A brief review is given of some of the conventions used to describe polarization effects in quasi-two-body reactions, in particular the helicity and transversity formalisms are discussed. The consequences of P, T and identical particle symmetry, as presented by Jacob and Wick, are examined using both formalisms. Some remarks are made concerning the general problem of amplitude analysis, the ambiguities which may be encountered, and how polarization measurements may help to reduce these considerably. (auth)

34675 PARTICLE INTERACTIONS AT VERY HIGH ENERGIES. Part A. Conference Held in Louvain, Belgium, August 12-25, 1973. Speiser, D.; Halzen, F.; Weyers, J. (eds.). NATO Advanced Study Institutes Series. New York; Plenum Publishing Corporation (1974). 410p. (CONF-730863-PA). $28.00.

Separate abstracts were prepared for the six papers presented. (JFP)

For abstracts of individual papers see: 34604, 34676-34678, 34694, and 35003.

34676 MODEL INDEPENDENT FEATURES OF DIFFRACTION. Halzen, F. (Univ. of Wisconsin, Madison). pp 1-60 of Particle Interactions at Very High Energies. Part A. Speiser, D. (ed.). New York; Plenum Publishing Corp. (1974).

From 2nd summer institute on particle interactions at very high energies; Louvain, Belgium (12 Aug 1973). See CONF-730863-PA.

An understanding of the high energy diffraction of hadrons without reference to specific models is given, and the picture of high energy scattering that emerges from the experimental data is shown constituting a guide to model building. Emphasis is placed on elastic scattering; particle production and its relation to elastic scattering is discussed in the framework of s-channel unitarity. Rigorous bounds on observables and their phenomenological relevance to high energy scattering data and diffraction as the shadow of particle production are treated. (JFP)

34677 STRONG INTERACTIONS AT VERY HIGH ENERGIES. Horn, D. (Tel Aviv Univ., Israel). pp 183-245 of Particle Interactions at Very High Energies. Part A. Speiser, D. (ed.). New York; Plenum Publishing Corp. (1974).

From 2nd summer institute on particle interactions at very high energies; Louvain, Belgium (12 Aug 1973). See CONF-730863-PA.

The lectures on strong interactions at very high energies cover inclusive phenomenology, the Mueller-Regge rules, analysis, inclusive correlations, and the multiperipheral model. (JFP)

34678 MULTI-BODY PHENOMENA IN STRONG INTERACTIONS. Jacob, M. (CERN, Geneva). pp 247-370 of Particle Interactions at Very High Energies. Part A. Speiser, D. (ed.). New York; Plenum Publishing Corp. (1974).

From 2nd summer institute on particle interactions at very high energies; Louvain, Belgium (12 Aug 1973). See CONF-730863-PA.

A survey of research at the CERN Intersecting Storage Rings during the last year, five main topics are considered: elastic scattering and, total cross sections, scaling and the approach to scaling, diffraction excitation, two-body correlations and finally, large transverse momentum phenomena. Experimental results are only briefly presented. They are discussed from a theoretical point of view, with emphasis on the information they give, the questions they raise and the type of further experiments which they suggest. The presentation tries to be self-contained. No attempt is made, however, to go into technical points and describe detailed model calculations. They are only referred to. (auth)

34679 CONSTITUENT QUARKS AND CURRENT QUARKS. Weyers, J. (CERN, Geneva). pp 43-95 of Particle Interactions at Very High Energies. Part B. Speiser, D. (ed.). New York; Plenum Publishing Corp. (1974).

From 2nd summer institute on particle interactions at very high energies; Louvain, Belgium (12 Aug 1973). See CONF-730863-PB.

Lectures are given reviewing the main ideas underlying recent developments in resonance physics covering the constituent and current quark pictures and their differences, the Melosh transformation in the free quark model, its possible extensions and its phenomenological consequences. Exact SU(3) invariance is assumed. (JFP)

34680 EXCHANGE DEGENERACIES IN THE PERIPHERAL ORBIT MODEL. Hara, Y.; Kuroda, T. (Tokyo Univ. of Education (Japan). Dept. of Physics). Progr. Theor. Phys. (Kyoto); 51: No. 5, 1416-1423(May 1974).

Patterns of exchange degeneracies of peripheral Regge poles are derived from the absence of exotic forward and backward peaks and from bootstrap conditions. (auth)

34681 TOWARDS NEW DUALISMS IN PARTICLE PHYSICS. Roy, P. (Tata Inst. of Fundamental Research, Bombay (India)). Phys. News (India); 4: No. 4, 73-77(Dec 1973).

An attempt has been made to convey some fundamental ideas on photon-hadron interactions that have emerged in the wake of recent experiments. The two theoretical concepts of "parton model" and "light cone physics" linked through Bjorken scaling are explained and the dualism that exists between these two ideas are elucidated. (INIS)

34682 RAPIDITY GAP CORRELATIONS IN SHORT RANGE ORDER MODELS. Pirila, P.; Thomas, G. H. (Argonne National Lab., Ill. (USA)). Nucl. Phys., B; 86: No. 3, 526-534(17 Feb 1975).

It is shown that short range order models relate the multiplicity distribution produced in a rapidity interval R of the central region, to the distribution of such intervals which all contain a fixed multiplicity N. This is an asymptotic result which furthermore implies that the asymptotic behavior of the Mueller moments be related to certain rapidity gap correlation moments. The behavior of these gap correlations in specific models depends in a direct way on the assumptions made about clustering and about the range of the interaction. (auth)

34683 REGGE THEORY FOR MULTIPARTICLE AMPLITUDES. Brower, R. C. (California Univ., Santa Cruz (USA)); DeTar, C. E. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science); Weis, J. H. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Rep.; 14: No. 6, 257-367(Dec 1974).

The asymptotic behavior of multiparticle scattering amplitudes is discussed and reviewed with an emphasis on the analytic structure of the amplitudes as a function of the channel invariants. Single and multiple asymptotic limits of the Regge and helicity type are defined, and a recipe is given for obtaining the asymptotic behavior of amplitudes in these limits controlled by exchanges of factorizable Regge poles and constrained by analyticity requirements. Applications to inclusive cross sections and the decoupling theorems for a pomeron Regge pole are reviewed as illustrative consequences of unitarity for multi-Regge theory. The present understanding of the relationship of cuts in angular momentum to unitarity is also described, and suggestions are given for further research. An effort has been made to keep the discussion pedagogical, while at the same time providing an entree to the literature. (auth)

34684 EFFECTS OF THE INCLUSIVE DIPOLE-POMERON TO EXCLUSIVE PROCESSES. Antoniou, N. G.; Kouris, C. B.; Papaioannou, G. M. (Democritus Nuclear Research Center, Athens (Greece)); Manesis, E. K. (Ioannina Univ. (Greece). Dept. of Physics). Phys. Lett., B; 55: No. 1, 77-80(20 Jan 1975).

The consequences of the inclusive dipole-Pomeron for the exclusive processes are investigated. In the weak coupling limit a two component picture for the production mechanism is obtained and self-consistency of the inclusive Pomeron dipole is found. (auth)

34685 DIFFRACTIVE SCATTERING IN THE DUAL MODEL. Chan, H. M. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.); Paton, J. E.; Tsou, S. T. (Oxford Univ. (UK). Dept. of Theoretical Physics). Nucl. Phys., B; 86: No. 3, 479-525(17 Feb 1975).

A method is suggested for calculating the elastic amplitude as the shadow of multiparticle processes. This does not require explicit formulas for the production amplitudes, but depends only on the following assumptions: (a) Regge behavior, (b) semi-local duality, (c) exchange degeneracy. The system is multiperipheral in general structure but because of the assumptions (a)-(c), it incorporates such features as the clustering of final particles and provides a proper treatment of quantum numbers, phases, and resonance spins. As a result, the unitarity sum separates automatically into two components corresponding respectively to pomeron and ordinary reggeon exchange, each of which is seen to have the correct qualitative dependence on the quantum numbers, the energy s, and the momentum transfer t. Quantitatively, the elastic amplitude is given in terms of a triple-Regge vertex, for which a simple parametrization based on a detailed study of existing experiment and the Veneziano model is suggested. The method is then applied to calculate the elastic amplitudes for $\pi^{\pm}p$, $K^{\pm}p$, and pp within the range $6 < s < 50$ and $0 > t > -0.5$ GeV^2. Semi-quantitative agreement is obtained with experiment with essentially no free parameter. Although the investigation is restricted at present to elastic scattering as the shadow of only the non-diffractive component satisfying (a)-(c), the method is believed to apply also to other diffractive processes, and may be regarded as the first step in an iterative solution of the full unitarity equation. (auth)

34686 QUARKS AND GLUE: EQUATIONS OF MOTION. Kaufmann, S. K. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 87: No. 1, 133-144(24 Feb 1975).

The concept of a linearly rising potential which serves to permanently bind quarks into hadrons is parlayed into field theoretic equations of motion for quarks and their accompanying glue fields. The usual fractionally charged quarks are assumed to be comprised of degenerate color triplets. The gluons are assumed to be the naturally accompanying octet of color gauge fields which are needed to make color an exact gauge symmetry. Fourth derivatives of the gluon fields occur in the equations of motion in order that the gluons may transit the permanently binding force. The quark-glue coupling is not minimal, but is rather assumed to have a large anomalous spin coupling term. This produces large spin–spin forces between quarks, which apparently are required to account for the large percentage mass difference between the pion and the rho. (auth)

34687 A GEOMETRICAL ASPECT OF MULTIPLICITY DISTRIBUTION AND ELASTIC DIFFRACTION SCATTERING. Minakata, H. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics). Progr. Theor. Phys. (Kyoto); 51: No. 5, 1481-1487(May 1974).

A simple geometrical picture is presented which leads to the compound Poisson-type multiplicity distribution. In this picture a specific choice of the distribution enables one to determine the inelastic overlap function. One takes the Pólya-Eggenberger distribution which was previously discussed. Elastic diffraction scattering is discussed by the use of the unitarity relation. A close connection between the long-range property of correlations and the shrinkage of the diffraction peak is found. (auth)

34688 MASS FORMULA FOR HADRONS AND A NONET SCHEME FOR MESONS. Fukuda, T. (Hiroshima Univ., Takehara (Japan). Research Inst. for Theoretical Physics); Yanagida, T.; Yonezawa, M. Progr. Theor. Phys. (Kyoto); 51: No. 5, 1406-1415 (May 1974).

The hadron mass formula is discussed in the quark-counting aspect. It is shown that the "free" quark picture gives the Gell-Mann-Okubo formula. A nonet mass formula for mesons is proposed and the inverted assignment for $\eta(549)$ and $\eta'(958)$ in the 0^- nonet is suggested. Classification of existing mesons into nonets is attempted. (auth)

34689 UNIVERSALITY OF URBARYON REARRANGEMENT AMPLITUDES. Igarashi, Y.; Matsuoka, T.; Sawada, S. (Nagoya Univ. (Japan). Dept. of Physics). Progr. Theor. Phys. (Kyoto); 51: No. 6, 1822-1835(Jun 1974).

The concept of universality of urbaryon rearrangement amplitudes is introduced, in which the amplitudes of the same type of urbaryon rearrangement for meson-meson, meson-baryon and baryon-(anti)baryon scattering are described as common with each other and the amplitudes of each type are counted even in the presence of the U(6) symmetry breaking, i.e., not pure f-type coupling. Relations for helicity nonflip and flip amplitudes are obtained on the basis of the concept of universality. Above all, it should be noticed that the following results are derived: The relations which comprise the Johnson-Treiman relations and the Freund relations as special cases are obtained and in good agreement with experiments if one takes D/F ratio of helicity nonflip part as $F_+ = f_+/(f_+ + d_+) = 1.5$. Universality relations for t-channel isoscalar part in helicity nonflip and flip amplitudes hold independently of D/F ratios. Universality relations for t-channel isovector part depend on D/F ratios. The experimental ratio of polarizations for K^+p-elastic scattering to that for pp^- can be explained reasonably. These results give support to the view that the countable nature of constituent urbaryons reflects on the scattering amplitudes for hadronic reactions. Furthermore, the validity of the universality of urbaryon rearrangement amplitudes suggests that urbaryon rearrangement interaction shares a coupling strength independent of the number of spectator urbaryons (the universality of urbaryon rearrangement interaction). (auth)

34690 STRUCTURE OF HADRON-HADRON COLLISION AT HIGH ENERGIES AND A NEW INTEGRAL EQUATION FOR PRODUCTION AMPLITUDES. Morii, T. (Kobe Univ. (Japan). Coll. of Liberal Arts); Noda, H. Progr. Theor. Phys. (Kyoto); 52: No. 2, 602-617(Aug 1974).

An integral equation for production amplitudes is formulated on the basis of the simplified multi-Regge model. The perturbative picture for the structure of the hadron-hadron interaction at high energies is presented. Its Born term is specified by the nondiffractive mechanism and the diffractive mechanism is

added to it. Furthermore, the reaction mechanism of the adjacent pomeron exchange is added to it as the correction. Such structure of the hadron-hadron interaction is suggested by the hierarchy among the inner couplings and the switch-over mechanism of the dominant reaction mechanism. The production of fireball and/or new particle in cosmic ray energy is included in the scheme. (auth)

34691 ASYMPTOTIC BEHAVIOUR OF THE PLANAR ONE-LOOP CORRECTION TO THE REGGE TRAJECTORY IN THE DUAL MODEL. Dorn, H. (Humboldt-Universitaet, Berlin); Kaiser, H. J. Acta Phys. Pol.; B6: No. 1, 17-31(1975).

The planar one-loop amplitude of the dual resonance model gives a first-order correction to the Regge trajectory. The analytic structure of this correction is investigated and its asymptotic behavior calculated. The problem of analytic continuation into the right half-plane is discussed. (auth)

34692 CHARGE TRANSFER FLUCTUATIONS IN THE NEUTRAL CLUSTER MODELS. Bialas, A. (Max-Planck-Inst. for Physics and Astrophysics, Munich); Fialkowski, K.; Jezabek, M.; Zielinski, M. Acta Phys. Pol.; B6: No. 1, 59-67(1975).

Charge transfer distribution in neutral cluster model of high-energy particle production is analyzed. Quigg and Thomas relation is derived for a realistic cluster decay distribution. The comparison with experimental data shows the agreement with the isotropic decay of clusters. Previous discrepancies are shown to be caused by neglecting the effects of non-zero initial charges. (auth)

Strong (Baryon No. = 0)

Refer also to abstract 35094.

34693 $W_0^+ W_1^-$ MESON PAIR FORMATION DUE TO POLARIZED PROTON–ANTIPROTON COLLISIONS. Kasumzade, Yu. M. (Azerbaidzhan State Univ., Baku). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 116-121(1974). (In Russian).

Previously theoretical models were examined in which in addition to the usual vector bosons there existed scalar bosons (spin 0 bosons). In the present study these are designated by W_1 and W_0. The process of proton-antiproton interaction with polarized initial particles is examined. The relation of these initial particles to the annihilation reaction in lepton-antilepton pairs is determined. The results show that there is a very clear difference in the behavior of the cross section of the annihilation process and the collision process. For values of the abnormal magnetic moment of the vector boson $x = -1$ the cross section of the collision process has a maximum at $E = 6m$ with meson mass $m_1 = 4m$ and $E = 13m$ with $m_1 = 8m$. With increase of the mass of the vector boson the curves of the energy dependence become mildly sloping and the maximum is displaced to the high energy side. The cross section of the collision process is very sensitive to the values of the mass and magnetic moment of the intermediate boson. The consideration of the magnetic moment of the boson strongly affects the pattern of the collision process. (JSR)

34694 PRODUCTION OF REGGE RECURRENCES. Michael, C. (CERN, Geneva). pp 385-395 of Particle Interactions at Very High Energies. Part A. Speiser, D. (ed.). New York; Plenum Publishing Corp. (1974).

From 2nd summer institute on particle interactions at very high energies; Louvain, Belgium (12 Aug 1973). See CONF-730863–PA.

For resonance states lying on a given Regge trajectory, the two-body production mechanism as a function of the excitation of the recurrence state is discussed. A dual resonance model suggests general features for the Regge-Regge-particle coupling involved in such production. An application is made to the high energy production in $\pi N \to \pi\pi N$ of ρ, f_0 and g mesons with emphasis on the relative production cross sections, the relative t dependences, the ratio of natural to unnatural parity exchange, and the helicity dependence. (auth)

34695 TIRED LIGHT, LORENTZ COVARIANCE, AND CONSERVATION PRINCIPLES. Yourgrau, W. (Univ. of Denver); Woodward, J. F. Acta Phys. Acad. Sci. Hung.; 37: No. 3, 283-285 (1974).

The Lorentz covariance and tired light solutions of the Proca equation are discussed. The Klein–Gordon equation for a massive, neutral, vector boson field is considered. (JFP)

34696 DECAY MODES OF THE ρ' AND ITS CONTRIBUTION TO THE ELECTROMAGNETIC FORM FACTORS. Bertlmann, R.; Kuehnelt, H. (Univ., Vienna). Acta Phys. Austr.; 38: No. 3, 295-299(1973).

It is shown that the strong suppression of the 2π decay mode of the recently established ρ' resonance is consistent with knowledge about $\rho\pi\pi$ and ρ-photon couplings and also with ρ dominance of the pion form factor. (auth)

34697 CHIRAL CONSTRAINTS IN DUAL MODELS. Ramachandran, R. (Indian Inst. of Tech., Kanpur). Pramana; 3: No. 5, 295-305(Nov 1974).

An attempt is made to see how much of chiral symmetry is contained in dual models for pseudoscalar mesons. The chiral constraints are found to be contained in dual models as either dynamical restriction or kinematical factors. At the phenomenological level there is no serious inconsistency. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 34591, 34593, 34620, and 34625.

34698 (ANL/HEP-75-02, pp VI.1-VI.52) POLARIZATION EFFECTS IN INCLUSIVE PROCESSES. Field, R. D. (California Inst. of Tech., Pasadena). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

The phenomenology of polarization and spin effects in inclusive processes is treated. These effects are examined using the triple-Regge formalism valid at large s/M^2 and large M^2, however the connection between this region and the small M^2 region via finite-mass sum rules (FMSR) and M^2-duality is emphasized. The two distinct types of polarization effects [i.e., type I = $(a_\uparrow \underline{b} c_\uparrow)$; type II = $(a \underline{b^\uparrow} c)$] are discussed separately and in detail. Examples and predictions are given and existing data examined. Other observables in inclusive processes are also mentioned briefly. (auth)

34699 RESONANCE AMBIGUITIES: BARRELET ZEROS, AND DUALITY IN $K^-p \to \Lambda\pi^0$. Van Horn, A. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., B; 87: No. 1, 157-175(24 Feb 1975).

The method of Barrelet zeros has been used to study the ambiguities of the partial wave solutions for the reactions $K^-p \to \Lambda\pi^0$ from 1550 to 2170 MeV. Details of this two-body analysis technique are presented and ambiguous sets of partial waves corresponding to the same $d\sigma/d\Omega$ and $(d\sigma/d\Omega)P$ are analyzed. Seven ambiguous solutions have been found which maintain the dominant Σ resonant structure [D3(1660), D5(1765), F5(1920), F7(2040)] but differ in the resonant couplings ($t = \sqrt{\Gamma_e \Gamma_r}/\Gamma$) for these states, as well as in the resonant structure in the lower partial waves. Evidence is given for the possible existence of new resonant states in the F5,D5 and F7 partial waves and for additional resonances in lower waves. The resonant structure suggested by the additional solutions is more prolific than the structure previously indicated for this reaction. Several solutions contain resonant "daughter" states at the same mass but with different J^P in qualitative agreement with Veneziano models and suggestive of the Harari–Freund conjecture of purely resonant scattering in non-diffractive, inelastic channels. The ambiguities are experimentally distinguishable only by measurement of R and A, which are predicted from the solutions. Each solution has been shown to be consistent with semi-local duality from observed averaging about zero exhibited by $\mathrm{Im}A'(s,t)$, the invariant, t-channel helicity non-flip amplitude calculated at $t = 0$ and at $t = m_{K^0_S}$. Local averaging was not seen in $B(s,t)$, the t-channel helicity flip amplitude. The variation of resonant coupling among these solutions for the dominant resonances suggests that SU(3) tests involving the $\Lambda\pi$ channel should be reconsidered. The results indicate that partial wave ambiguities should be more carefully studied and that the possible Σ resonances should be looked for in other KN reactions. (auth)

34700 IMPACT PARAMETER DESCRIPTION OF THE CHARGE EXCHANGE PROCESS $\pi^+p \to \pi^0(\pi^+p)$. Ader, J. P.; Humble, S.; Peschanski, R. (European Organization for Nuclear Research, Geneva (Switzerland)); Lacaze, R. (Geneva Univ. (Switzerland). Inst. de Physique Theorique). Phys. Lett., B; 55: No. 1, 71-76(20 Jan 1975).

The "Reggeometry" model—universal impact parameter profile and Reggeon behavior—is applied to recent data on $\pi^+p \to \pi^0(p\pi^+)$ at different energies and (π^+p) missing masses, including Δ production. In particular, the filling of the dips and the variation of the slope with respect to the missing mass can be explained. (auth)

34701 STRUCTURE OF INNER COUPLINGS IN EXCLUSIVE REACTIONS. Morii, T. (Kobe Univ. (Japan). Coll. of Liberal Arts); Noda, H. Progr. Theor. Phys. (Kyoto); 52: No. 1, 218-229 (Jul 1974).

The magnitude of the inner couplings is investigated from the analyses of partial cross sections of π^-p and pp interactions by means of a simplified multi-Regge model. It is clarified that the inner pomeron coupling g^3_{PM} is very small compared with the inner-meson one g^3_{MM}, i.e., $g^3_{PM}/g^3_{MM} \simeq 0.01$. This result leads to a switch-over mechanism of the dominant reaction mechanism with increasing energy. (auth)

34702 SCALING TEST IN π^-p SEMI-INCLUSIVE REACTIONS. Krasznovsky, S. (Central Research Inst. for Physics, Budapest); Ponta, T. Rev. Roum. Phys.; 19: No. 10, 1095-1100(1974).

The scaling properties of the semi-inclusive reactions $\pi^- p \to \pi^- + (n-1)$ charged + neutrals at 7.5, 21, and 40 GeV/c are investigated. The distributions of the normalized Lorentz invariant single-particle semi-inclusive cross sections (h-functions) on the x variable for the outgoing π^- particles indicate the presence of a limited scaling. The sum rule concerning the cross sections of the studied reactions was also tested at 21 and 50 GeV/c. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 34600, 34608, 34624, 34737, and 34790.

34703 (ANL/HEP-75-02, pp IV.1-IV.8) QUADRATIC RELATIONS AMONG OBSERVABLES IN p-p SCATTERING. Delaney, R. M.; Gammel, J. L. (St. Louis Univ.). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22-26, 1974.

A complete set of observables for p-p scattering were given by Halzen and Thomas (Phys. Rev. D. 10: 344(1974)). Since there are 5 amplitudes, there are 25 observables. The amplitudes are complex numbers, but their overall phase is not observable, and therefore only $2 \times 5 - 1 = 9$ of the 25 observables can be independent of each other. Thus there must be $25 - 9 = 16$ independent quadratic relations among the 25 observables. One such set of 16 relations are worked out. The method applies to any like problem. (auth)

34704 (ANL/HEP-75-02, pp XX.1-XX.5) POLARIZED DEUTERON BEAMS. Abolins, M. (Michigan State Univ., East Lansing). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22-26, 1974.

Copius beams of polarized or aligned deuterons can be produced by the Argonne ZGS. Detailed considerations of the scattering of polarized or aligned deuterons on protons, using the framework of the Glauber double-scattering formalism, show that a rich structure is produced in the differential cross sections. This structure depends mainly on the fraction of d-state in the deuteron wave function and the details of the nucleon-nucleon scattering amplitudes. It is suggested that through such experiments one could gain valuable information about the deuteron wave function, the ratio of real to imaginary parts of the nucleon-nucleon scattering amplitudes at sizeable momentum transfers and at the same time to perform a sensitive test of the double scattering formalism itself. (auth)

34705 (ANL/HEP-75-02, pp XXIII.1-XXIII.3) AMPLITUDE ANALYSIS IN p-p SCATTERING. Buttimore, N. H. (Univ. of Dublin). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22-26, 1974.

It is pointed out that the unnatural parity exchange contributions can be eliminated in the amplitude analysis for pp scattering by a suitable combination of polarization measurements. (LBS)

34706 (ANL/HEP-75-02, pp XXVI.1-XXVI.23) POLARIZATION IN HIGH ENERGY HADRON REACTIONS. Soffer, J.; Wray, D. (CERN, Geneva). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22-26, 1974.

The contents of this discussion are as follows: spin effects in pp elastic scattering near the forward direction; polarization in inclusive processes; a diffractive model including spin for pp elastic scattering at very high energy; and implications of the spin dependent model for earlier theoretical work and present and future experiments. (LBS)

34707 (JINR-E2-8488) HARMONIC ANALYSIS ON THE LORENTZ GROUP, QUASIPOTENTIAL APPROACH AND PROTON-PROTON ELASTIC SCATTERING AT HIGH ENERGIES. Mavrodiev, S. Ch.; Karadjov, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 13p. Dep. NTIS (US Sales Only) $4.00.

The exponential-power behavior of the proton-proton elastic differential cross section is proved by numerical analysis. The scattering amplitude in Born approximation is obtained under the assumption for a simple quasipotential to exist in relativistic relative coordinate space. (auth)

34708 THE ABC EFFECT IN THE REACTION NN → d$\pi\pi$. Bar-Nir, I. (European Organization for Nuclear Research, Geneva (Switzerland)); Risser, T. (California Univ., Santa Barbara (USA). Dept. of Physics); Shuster, M. D. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). Nucl. Phys., B; 87: No. 1, 109-126(24 Feb 1975).

A simple peripheral model for the reaction NN → NN$\pi\pi$ is extended to the reaction NN → d$\pi\pi$. Predictions for the differential and total cross sections are compared with recent experiments. The enhancements of the deuteron recoil-momentum spectrum near the $\pi\pi$ threshold (ABC effect) is well reproduced. (auth)

34709 FINAL STATE INTERACTIONS IN LARGE TRANSVERSE MOMENTUM LEPTON AND HADRON PRODUCTION. Tar, C. E. de; Ellis, S. D.; Landshoff, P. V. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 87: No. 1, 176-188(24 Feb 1975).

It is shown that, in standard parton models, initial and final state interactions do not contribute to the leading asymptotic behavior of the single particle inclusive cross section for the production of a large P_T lepton or hadron in hadron-hadron collisions. However, they do have an important effect on the distribution of accompanying small P_T hadrons: superimposed on the large P_T event is a "pionization" distribution characteristic of ordinary hadron-hadron collisions. Thus, for example, the cross section for massive lepton pair production is given simply by the Drell-Yan term, though this does not by itself describe the accompanying final state hadrons. (auth)

34710 ELASTIC PION-DEUTERON SCATTERING IN THE RESONANCE REGION AS A THREE-BODY PROBLEM. Myhrer, F.; Koltun, D. S. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy). Nucl. Phys., B; 86: No. 3, 441-460(17 Feb 1975).

Elastic pion-deuteron scattering is studied in the $\Delta(1236)$ energy region by means of the three-body Faddeev equations. A compact angular momentum reduction of the Faddeev integral equation is presented for separable amplitudes, neglecting the nucleon spin, and the resulting coupled integral equations are solved. The dependence of the elastic scattering amplitude on the deuteron structure, on the pion-nucleon scattering amplitude, and on the various orders of multiple scattering is examined. The differential cross section is very sensitive to multiple scattering effects at backward angles. It is found that a number of conventional approximations do not well reproduce these multiple scattering effects in the resonance region. (auth)

34711 CORRELATION COEFFICIENTS IN THE CONSTITUENT INTERCHANGE MODEL. Schiff, D.; Contogouris, A. P.; Alonso, J. L. (Paris-11 Univ., 91-Orsay (France). Lab. de Physique Theorique et Particules Elementaires). Phys. Lett., B; 55: No. 1, 87-92(20 Jan 1975).

Correlation coefficients (CC) for two large transverse momentum hadrons are studied in the constituent interchange model. For $p + p \to \pi^0 + \pi^0 + X$ when the two π^0's are produced in opposite directions with momenta p_{TC}, P_{TD} the model predicts significant structure of the CC at $p_{TC} \sim p_{TD}$; and when the two π^0's are produced in the same direction it predicts a very small CC. Comparison with existing data is also given. (auth)

34712 NON-WEE PARTONS AND RISING pp TOTAL CROSS SECTION. Bartelski, J.; Krolikowski, W. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 22: No. 12, 1261-1265(1974).

One assumes that the growing number of nonwee partons in the "sea" is responsible for the rising pp total cross section. Then its asymptotic form is $B_0 + B_1 \log^2 s/s_L$, in consistency with experimental fits. Assuming that the nonwee partons in the "sea" emit hadron clusters one obtains for the average number of produced hadrons the asymptotic form $C_0 + C_1 \log s/s_L$, in a reasonable agreement with the experimental data. The picture presented is an alternative for the defreezing parton model discussed previously, which gives a step-like structure of the rising pp total cross section. (auth)

34713 ARE THERE STEPS IN THE RISING PROTON-PROTON CROSS SECTION. Bartelski, J.; Krolikowski, W. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 22: No. 12, 1267-1272(1974).

The defreezing-parton model proposed previously, predicting a step-like structure of the rising proton-proton total cross section, is used to interpret some recent FNAL data which may support this picture. (auth)

34714 ALL-ANGLE BEHAVIOR OF TWO-BODY SCATTERING AND URBARYON REARRANGEMENT. Igarashi, Y.; Matsuoka, T.; Sawada, S. (Nagoya Univ. (Japan). Dept. of Physics). Progr. Theor. Phys. (Kyoto); 52: No. 2, 618-635(Aug 1974).

From the viewpoint of urbaryon rearrangement, the scattering amplitudes, which represent two-body reactions for overall angle, are proposed. The overall amplitudes specified by the basic number of rearranged urbaryons in s-, t- and u-channels have Regge-like behavior in small momentum transfer region and the simple scaling form in large momentum transfer region.

The proposed amplitudes are compared with experiments for pp, $\bar{p}p$ and K^+p elastic scattering and reproduce fairly well the gross features of their all-angle differential cross sections. It is also pointed out that independent particle picture gives understanding of the scaling behavior of the proposed amplitudes in large momentum transfer region. (auth)

34715 DIFFERENTIAL CROSS SECTION AND POLARIZATION EFFECTS IN pp → pN*AND SU(6) ⊗ O(3) STRUCTURE Hirano, M. (Hokkaido Univ. of Education, Sapporo (Japan)); Iwata, K.; Matsuda, Y.; Murota, T. Progr. Theor. Phys. (Kyoto); 51: No. 6, 1801-1821(Jun 1974).

On the basis of the symmetric quark model, the differential cross section and the polarization effect in pp → pN* is calculated. These quantities are related to the NN elastic scattering amplitude by assuming that N and N* have SU(6) ⊗ O(3) structure. The results show that it seems possible to explain the reaction NN → NN* by their SU(6) ⊗ O(3) structure. However, the knowledge on the helicity and isospin dependence of the input NN elastic scattering amplitude is not enough to derive more detailed conclusions. (auth)

34716 ONE-PARTICLE (REGGE) EXCHANGE MECHANISM AND INCLUSIVE HYPERON (Λ, Σ, AND Y_1^*) PRODUCTION. Kasahara, T. (Tohoku Univ., Sendai (Japan). Dept. of Physics). Progr. Theor. Phys. (Kyoto); 51: No. 6, 1836-1850(Jun 1974).

A hyperon production in the inclusive reaction p+p → Λ(Σ)+ anything (X) is studied by K- and K*-Regge exchange mechanism. Not only a direct production by the Regge exchange but also a contribution of the decay products from Y_1^* are considered. It is possible to get satisfactory fits to the data by this mechanism. The decay products of Y_1^* compensate for the shortage of the direct production in a manner fairly consistent with duality. (auth)

34717 BOUNDS ON AVERAGE MULTIPLICITY AND TRANSVERSE MOMENTUM IN HIGH-ENERGY HADRON COLLISION. Yokomi, H.; Yotsuyanagi, I. (Osaka Univ., Toyonaka (Japan). Faculty of Engineering Science). Progr. Theor. Phys. (Kyoto); 51: No. 6, 1851-1864(Jun 1974).

Using the energy conservation law and the experimental fact that the single-particle distribution function in high energy inclusive reaction $a + b \to c + X (c \neq a,b)$ is bounded as $E_c(d^3\sigma c/dp_c^3) \leq A_c$, the following inequalities are proven for average multiplicity and transverse momentum of measured particle c: $\langle n_c \rangle < \text{const } (A_c s/\sigma_{in})^{\frac{1}{4}}$, $\langle n_c \rangle < \text{const } (A_c/\sigma_{in})\ \langle Prc \rangle^2 \log s$, A_c being a constant or possibly a function of s. For the reactions a + b → (a or b) + X, similar inequalities are also derived by taking into account the diffraction peak. These bounds become severe if a scaling is assumed. A comparison with recent high energy data is made. (auth)

34718 ON THE SLOPE PARAMETER OF FORWARD PROTON-PROTON SCATTERING. Takaya, Y. (Meteorological Coll., Kashiwa, Chiba (Japan)). Progr. Theor. Phys. (Kyoto); 51: No. 5, 1433-1436(May 1974).

By analyzing the data concerning the slope parameter of the differential cross sections of the forward peak for elastic pp scattering from the threshold up to the ISR energies, it is shown that the nonresonating background is described in two terms: One is controlled by the pole in the complex J-plane which is kept fixed against the variable n^2. The other is controlled by the pole which moves against s linearly. (auth)

34719 SOME DIFFICULTIES IN REGGE-POLE ANALYSIS OF INCLUSIVE REACTION p+p → Δ^{++} (1236)+ANYTHING. Kasahara, T.; Akiba, T. (Tohoku Univ., Sendai (Japan). Dept. of Physics). Progr. Theor. Phys. (Kyoto); 51: No. 5, 1473-1480 (May 1974).

The Δ-resonance production in the inclusive reaction p + p → Δ^{++} (1236) + "anything" is studied by π- and ρ-Regge exchange mechanism. Though it is possible to get fairly good fits to the data by this mechanism, a feature of the data leads one to consider a novel behavior of the absorption effect accompanying the π-exchange. In general, this behavior of the absorption seems to be important for understanding adequate suppression of low multiplicity events at high energies. (auth)

34720 ENERGY DEPENDENCE OF MULTIPLICITY IN PROTON–NUCLEON COLLISIONS AND MODELS OF MULTIPARTICLE PRODUCTION. Gurtu, A. (Tata Inst. of Fundamental Research, Bombay); Malhorta, P. K.; Mittra, I. S. Pramana; 3: No. 5, 311-322(Nov 1974).

This is a continuation of an earlier investigation (Gurtu et al 1974 Phys. Lett. 50B 391) on multiparticle production in proton–nucleus collisions based on an exposure of emulsion stack to 200 GeV/c beam at the NAL. It is found that the ratio $R_{em} = \langle n_h \rangle / \langle n_{ch} \rangle$, where $\langle n_{ch} \rangle$ is the charged particle multiplicity in pp-collisions, increases slowly from about 1 at 10 GeV/c to 1.6 at 68 GeV/c and attains a constant value of 1.71 ± 0.04 in the region 200 to 8000 GeV/c. Furthermore, $R_{em} = 1.71$ implies an effective A-dependence of $R_A = A^{0.18}$, i.e., a very weak dependence. Predictions of R_{em} on various models are discussed and compared with the emulsion data. Data seem to favor models of hadron–nucleon collisions in which production of particles takes place through a double step mechanism, e.g., diffractive excitation, hydrodynamical and energy flux cascade as opposed to models which envisage instantaneous production. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstract 34626.

34721 (ANL/HEP-75-02, pp XII.1-XII.32) POSSIBLE SYMMETRY VIOLATIONS IN HADRON SCATTERING. Henley, E. M. (Univ. of Washington, Seattle). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

The discussion is restricted to symmetries which can be tested by means of polarized beams or targets. In particular, only time reversal and parity symmetries are discussed. (auth)

34722 SUPERSYMMETRY AND FERMION-NUMBER CONSERVATION. Salam, A.; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Nucl. Phys., B; 87: No. 1, 85-92(24 Feb 1975).

The appearance of Majorana fermions in supersymmetric theories makes the conservation of fermion- (baryon- or lepton-) number (particularly in those models which are renormalizable) something of a problem. To solve this problem, it appears necessary to tolerate some bosons with fermion-number two. (auth)

34723 DOUBLE COSET ANALYSIS FOR SYMMETRY ADAPTING Nth RANK TENSORS OF U(n) TO ITS UNITARY SUBGROUPS. Sullivan, J. J. (Univ. of New Orleans). J. Math. Phys. (N. Y.); 16: No. 4, 756-760(Apr 1975).

Representations of the unitary group U(n) symmetry adapted to the subgroup sequences are considered using double coset decomposition. The matrix elements of the double coset

$$U(n) \nearrow \otimes\ U(n_j) \searrow \otimes\ U(i\,n_j)$$
$$\searrow \otimes\ U(i_1 n) \nearrow$$

representatives are related to identical coefficients developed in an analogous manner for the symmetric group [J. J. Sullivan, J. Math. Phys. 14, 387 (1973)].

Applications (Electromagnetic and Weak)

Refer also to abstract 34650.

34724 (ANL/HEP-75-02, pp XXXI.1-XXXI.17) PARITY VIOLATION IN PROTON SCATTERING. Anderson, H. L. (Univ. of Chicago). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

An experiment proposed to measure parity violation in proton scattering is discussed. (LBS)

Applications (Strong)

34725 CHIRAL SYMMETRY AND THE HADRON SPECTRUM. Carlitz, R. (Univ. of Chicago). pp 97-130 of Particle Interactions at Very High Energies. Part B. Speiser, D. (ed.). New York; Plenum Publishing Corp. (1974).

From 2nd summer institute on particle interactions at very high energies; Louvain, Belgium (12 Aug 1973). See CONF-730863–PB.

The lectures on chiral symmetry and the hadron spectrum cover the chiral SU(3) × SU(3) algebra, consequences of chiral symmetry, current quarks and spectrum quarks, and the consequences of the Melosh transformation. (JFP)

34726 PHYSICAL LADDERS AND RELATIVISTIC GENERALIZATIONS. Nikolov, A. (Univ. of Sofia). Ann. Phys. (N. Y.); 89: No. 1, 181-192(Jan 1975).

The research on the relativization of the hadron classification scheme, connected with the U(6,6)-ladders is continued. For this purpose the semidirect product U(6,6) · T(143) and its Lie algebra are used. A representation of U(6,6) · T(143) is built with its help the generalized momenta and the generalized angular momenta are introduced. By means of their combinations with

the ladder momenta a representation of mentioned algebra is built; this representation namely gives a possibility the relativization of the considered scheme to be carried out. Finally, it is asserted, that the corresponding hadron classification is relativistic invariant. (auth)

34727 STUDY OF η-η' MIXING AND SU(4) QUARTET SCHEME. Suzuki, T. (Kanazawa Univ. (Japan). Dept. of Physics). Progr. Theor. Phys. (Kyoto); 51: No. 6, 1893-1906(Jun 1974).

It is shown that the so-called Okubo ansatz and Iizuka rule in the quark model are not applicable to reduced matrix elements involving isoscalar 0^-mesons, whereas their generalization to the SU(4) quartet scheme are very successful in describing unifiedly all vertices with isoscalar mesons. As a result, η' (958) should not be assigned predominantly to the SU(4) singlet state, but rather to the 15-plet state in order to explain especially the suppression of η' production compared with η in nN scattering. This leads one to that other symmetry breaking term then $(4, 4^*) \oplus (4^*, 4)$ must be considered in chiral SU(4) $\otimes$ SU(4) scheme. (auth)

Scattering Theory

Refer also to abstract 35103.

34728 (JUL-1150-FF) CLASSICAL POTENTIAL SCATTERING AS THE LIMITING CASE OF A QUANTUM MECHANICAL WAVE PACKET THEORY. Drepper, F. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung). Dec 1974. 65p. (In German). Dep. NTIS (US Sales Only) $6.25.

Thesis. Submitted to Technische Hochschule, Aachen.

A new method for the transition from quantum to classical mechanics in potential scattering theory is presented. The incoming wave packet is decomposed into many narrow wave packets with different impact parameters, whose width becomes small inside the potential. In the classical limit this decomposition has the following two properties: Only certain impact parameters depending on the direction of observation contribute to the transition amplitude. In the equation of motion for each narrow wave packet the potential can be expanded about the momentary center of mass. To get the classical cross section in general directions terms of second order have to be included. (auth)

34729 UNITARITY AND REGGE BRANCH POINTS. Joshi, G. C. (Univ. of Melbourne); Pagnamenta, A. Aust. J. Phys.; 27: No. 6, 745-749(Dec 1974).

It is shown how t-channel unitarity imposes constraints on the discontinuity associated with the leading Regge branch point. If the discontinuity across the leading Regge cut does not vanish at the end point it leads to the "Gribov paradox." (auth)

34730 MULTIPLE SCATTERING EFFECTS IN A THREE-PARTICLE SYSTEM. Cahill, R. T.; Poole, M. S. (Flinders Univ. of South Australia, Bedford Park). Aust. J. Phys.; 27: No. 6, 751-757(Dec 1974).

It is shown that the phenomenological target wave function cutoff prescription arises naturally in the fixed scatterer approximation to particle scattering from a two-particle bound state. The wave function modification is found to describe the effects of higher order multiple scattering. (auth)

34731 MAGNUS EXPANSION AND EIKONAL APPROXIMATION IN POTENTIAL SCATTERING. Krueger, H. (Trier-Kaiserslautern Univ., Kaiserslautern (F.R. Germany). Fachbereich Physik); Tip, A. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). Phys. Lett., A; 51: No. 1, 36-38(27 Jan 1975).

An expansion procedure due to Magnus is applied to the case of potential scattering. This technique, which is superior to the usual Born–Dyson expansion in that it preserves unitarity at each state, leads in first approximation to an expression for the scattering amplitude which contains as special cases the eikonal approximation and also the second Born approximation. In particular the first Magnus approximation provides a basis for the ad hoc addition of the real part of the second Born contribution to the eikonal scattering amplitude as was considered by Byron et al. (auth)

34732 COCHASE, A CODE FOR COUPLED CHANNEL SCHROEDINGER EQUATIONS. Hirschi, S.; Lomon, E.; Spencer, N. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). Comput. Phys. Commun.; 9: No. 1, 11-30(Jan 1975).

The computer code COCHASE is designed to calculate the S-matrix in the form of a real phase shift and elasticity for the interaction of two particles coupled to the possible production of five other two particle channels. The production cross section for each secondary channel is also easily obtained. The method of solution is to solve a set of coupled differential Schrodinger equations for the wave functions in each channel using a fourth order Runge–Kutta routine. Two simultaneous transcendental equations which involve these wave functions are then solved using the Newton–Raphson technique to find the phase shift and inelasticity. (auth)

34733 UNBOUND MOTION AND SCATTERING. Corbett, J. V. (Indiana Univ., Bloomington). Nuovo Cim., 25B: No. 1, 103-124(11 Jan 1975).

Bound- and unbound-motion states are defined by the asymptotic behavior of the radial separation. A distinction between unbound-motion states and scattering states is made and conditions are obtained under which unbound-motion states are scattering states. (auth)

34734 SCATTERING PROBLEMS IN RELATION TO THE INDEFINITE STATE. Hsia, T. H. (Futan Univ., Peking). Shu-hsueh Hsueh-pao; 17: No. 1, 60-75(Mar 1974). (In Chinese).

An analysis is given of the latest proposed theory concerning the quantum field. A verification of the nonsingularity property of the scattering operator is given through the application of the indefinite state. Thus, a general expression of the scattering operator is obtained. In addition, a concrete form of the Lee's model jet scattering matrix element is introduced. (JPRS)

34735 PARTICLE IN THE FIELD OF SCATTERING DELTA POTENTIALS. Zhdanov, S. K.; Chikhachev, A. S. (Moscow Engineering-Physics Inst.). Dokl. Akad. Nauk SSSR; 218: No. 6, 1323-1326(21 Oct 1974). (In Russian).

In a series of cases for the description of specific physical situations it is necessary to study the behavior of one particle in a background of a given movement of the remaining parts of the system. In the present study the behavior of a particle in the field of attraction of two δ potentials diverging with constant velocity is examined. (JSR)

34736 ANGULAR MOMENTUM ANALYSIS OF A COMPOSITE PARTICLE SCATTERING PROBLEM AND ITS CROSS CHANNEL ANALOG. Jackson, S. A. (Fermi National Accelerator Lab., Batavia, IL). Ann. Phys. (N. Y.); 89: No. 1, 168-180(Jan 1975).

The solutions, by a determinental method, for a partial wave Bethe–Salpeter equation describing composite particle scattering and for its cross channel analog. The behavior at $s = -\infty$ of the leading angular momentum singularity from the Bethe–Salpeter equation is compared with that of the leading Regge singularity of the cross channel equation. The effect of the general properties of the kernel of the Bethe–Salpeter equation on the angular momentum structure of the solution is mentioned. (auth)

34737 POMERON STRUCTURE AND MULTIPLE-PRODUCTION MECHANISMS. Kagiyama, S. (Fukuoka Univ. (Japan). Faculty of Science). Progr. Theor. Phys. (Kyoto); 51: No. 5, 1488-1495(May 1974).

A realistic model for the Pomeron is proposed on the basis of two mechanisms of multiperipheral and diffractive productions. It is a basic assumption in the model that the unitarity reflection from the multiperipheral component produces the "bare" Pomeron pole and the "elastic" Pomeron is clouded by the cut contributions from the diffractive component whose contributions are estimated by the inclusive data $pp \rightarrow pX$. The model can explain satisfactorily the rapid increase of σ_{tot} at ISR energies. The behavior of σ^{el} and $d\sigma^{el}/dt$ can also be reproduced by the model. (auth)

34738 COMMENTS ON DOUBLE-PARTIAL-WAVE CALCULUS OF ABSORPTIVE REGGE SINGULARITIES. Fujisaki, H.; Akiba, E.; Mutoh, S. (Rikkyo Univ., Tokyo (Japan). Dept. of Physics). Progr. Theor. Phys. (Kyoto); 51: No. 6, 1874-1878 (Jun 1974).

It is shown that the method of the double-partial-wave amplitude is successfully applicable to examination of the structure of 1-plane singularities associated with Reggeized absorption in the presence of single- and double-pole Pomerons. (auth)

34739 COMMENTS ON DOUBLE-PARTIAL-WAVE CALCULUS OF ABSORPTIVE REGGE SINGULARITIES. II. Fujisaki, H.; Mutoh, S.; Akiba, E. (Rikkyo Univ., Tokyo (Japan). Dept. of Physics). Progr. Theor. Phys. (Kyoto); 52: No. 1, 196-217 (Jul 1974).

The double-partial-wave procedure is applied to examination of the structure of absorptive Regge singularities in the presence of grey and black Gaussian Pomerons with logarithmically divergent radius. It is shown that, if and only if opacity at $b = 0$ is

saturated, the input Regge pole is cancelled by the absorptive leading Regge singularity. (auth)

34740 CONVERGENCE OF PADE APPROXIMANTS USING THE SOLUTION OF LINEAR FUNCTIONAL EQUATIONS. Baker, G. A. Jr. (Brookhaven National Lab., Upton, NY). J. Math. Phys. (N. Y.); 16: No. 4, 813-822(Apr 1975).

It is proven that a projection of the solutions to a linear functional equation of the Fredholm type with a compact kernel, projected into the Cini-Fubini subspaces, converge strongly to the solution in the whole space. Either the whole sequence converges for all nonsingular points of the functional equation with at most one exceptional point, or by selecting at most two infinite subsequences one can obtain convergence for all nonsingular points. It is then proven that the diagonal Padé approximants to the inner product of the solution with another element converge. For certain kernels of trace class, the numerator and denominator separately converge. As applications of these results, the pointwise convergence of the Padé approximants to a wide class of meromorphic functions is proven. Also the convergence, for decent potentials, of the Padé approximants to the scattering amplitudes for nonrelativistic quantum mechanical scattering problems is proven. The numerators and denominators of the Padé approximants to the partial wave scattering amplitudes or single signed potentials converge separately to entire functions of the coupling constant. (auth)

34741 EXPERIMENTAL UNCERTAINTIES IN THE PROBLEM OF THE UNITARITY EQUATION. Tortorella, M. (Univ. of Wisconsin, Milwaukee). J. Math. Phys. (N. Y.); 16: No. 4, 823-828(Apr 1975).

The question of how experimental uncertainties affect the construction of the scattering amplitude from the differential cross section and unitarity at a fixed energy is examined. It is shown that in most cases in which the solution can be found by the method of Newton and Martin, the problem is "well posed" in the sense that the solution depends continuously on the data. A new proof is given of the fact that if the differential cross section is nearly constant and small enough, there is a unique solution of the problem. Some estimates for the scattering amplitude and other functions of interest are given. (auth)

34742 TEMPORALLY INHOMOGENEOUS SCATTERING THEORY FOR MODIFIED WAVE OPERATORS. Hendrickson, J. H. (Univ. of New York, Binghamton). J. Math. Phys. (N. Y.); 16: No. 4, 768-771(Apr 1975).

A theorem of Alsholm and Kato, which gives existence of modified wave operators for a large class of long range potentials, is extended to include time-dependent potentials. It is then shown that these temporally inhomogeneous modified wave operators $W_{D_s}(S)$ vary continuously, in some sense, on the potentials. This result is new for both time dependent and time independent potentials. In addition, part of the nonuniqueness problem of modified wave operators is resolved by noting that the modified wave operators are asymptotically unique. (auth)

34743 APPLICATION OF THE METHOD OF THE FORMAL SERIES TO THE VARIABLE PHASE APPROACH. Atanasov, A. A.; Ivanov, K. I. (Univ. of Ploydiv, Bulgaria). Acta Phys. Pol.; B6: No. 1, 129-138(1975).

The method of formal series can be applied to solving the variable phase equation for partial amplitude, to relativistic potential, theory and quasipotential approaches. The partial amplitude is represented by the ratio of two power series of the coupling constant. (auth)

34744 KINEMATIC CONSTRAINTS ON RHA $\bar{1} + 0 \rightarrow \frac{1}{2} + \frac{1}{2}'$ REACTIONS. Sewerynski, M. (Inst. for Nuclear Research, Warsaw). Acta Phys. Pol.; B6: No. 1, 33-48(1975).

The complete set of kinematic constraints on the regularized helicity amplitudes (RHA) for $\bar{1} + 0 \rightarrow \frac{1}{2} + \frac{1}{2}'$ reactions is given. All interesting external mass configurations are covered and both parities of the reaction are taken into account. (auth)

34745 DUAL POLE EIKONAL AND S-CHANNEL SINGULARITIES. Biswas, S.; Dasgupta, P. (Univ. of Kalyani, India). Pramana; 3: No. 5, 306-310(Nov 1974).

Eikonalization of dual pole amplitudes, such as the Veneziano amplitude, is shown to lead to singularities in the impact parameter plane, which, in the eikonal approximation, may be interpreted as branch points in the direct channel angular momentum plane. This result is discussed in the light of dual absorption models. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

Refer also to abstract 35070.

34746 (AECL-4931, p 60) MOMENTUM DISTRIBUTION IN LIQUID He II. Sears, V. F. Oct 1974.

In Physics Division progress report, July 1 to September 30, 1974.

34747 NON-CLASSICAL THERMOMECHANICAL CONVECTION IN SUPERFLUID LIQUID HELIUM II. Amar, R. C. Los Angeles; Univ. of California (1974). 151p. University Microfilms Order No. 75-5702.

Thesis (Ph. D.).

Non-classical phenomena in superfluid He II in the presence of thermomechanical driving forces are investigated. The peak heat flux, q*, at which vaporization initiates at the heated surface of a horizontal gallium cylinder (d = 0.12 cm) immersed in a bath of liquid He II (resulting in enhanced thermal impedances) is measured for various immersion depths $0 < H < 15$ cm and at temperatures (T) close to the λ-point, $1.80\ K < T < T_\lambda$. The heat transfer problem has also been investigated analytically using simplified thin film approximations of the boundary layer equations for a disordered He II liquid layer and also using "zero-net mass flow" and critical state condition. The results of the model calculations are compared with the experimental data and related previous work. The model predicts the salient features of the experimental data q(ΔT) close to the λ-point. Thermomechanical flow rates have also been measured through a bundle of narrow channels ($d_h = 1.4 \times 10^{-3}$ cm). These finite mass flow data have been correlated with the same dimensionless numbers N_q ($=jd_h/\eta_n$), (ρ_s/ρ) and $N_{\nabla p_T}$ representing the transport of liquid helium, state of order and the driving force respectively. Similarity of the finite mass flow data with the present "zero-net mass flow" results (horizontal cylinder data) has been demonstrated. (MHR)

34748 BRILLOUIN SCATTERING FROM SUPERFLUID ^{3}He–^{4}He SOLUTIONS. Rockwell, D. A.; Benjamin, R. F.; Greytak, T. J. (Massachusetts Inst. of Tech., Cambridge). J. Low Temp. Phys.; 18: No. 5/6, 389-425(Mar 1975).

Brillouin scattering experiments were carried out in superfluid ^{3}He–^{4}He solutions at six molar concentrations (x = 0.050, 0.100, 0.135, 0.250, 0.398, and 0.606) for temperatures as low as 0.4 K. The relative scattered intensities from the three normal modes: first sound, second sound, and concentration fluctuations were measured. The velocity of high-frequency first sound (~600 MHz), the velocity of high-frequency second sound (~20–80 MHz), and, at low concentrations, rough indications of the damping of the modes were obtained. An exact calculation of the scattered intensities is presented and used together with our measured intensities to obtain values for three thermodynamic quantities: ρ_n/ρ, $(\partial\Delta/\partial X)_{P,T}$ and $(\partial\Delta/\partial T)_{P,X}$. (auth)

34749 THEORY OF NONDISSIPATIVE FLOW IN THE HELIUM FILM. Goodstein, D. L.; Saffman, P. G. (California Inst. of Tech., Pasadena). J. Low Temp. Phys.; 18: No. 5/6, 435-455 (Mar 1975).

The necessary conditions are examined for a film in contact with its own vapor to flow without dissipation. When the local gas is in equilibrium with the vapor of a bulk reservoir, the equilibrium thickness of the flowing film is the same as that of the film at rest. For nonsteady flow, the predicted thickness depends on a nonequilibrium condition that cannot be deduced from thermodynamic arguments. A plausible form is proposed for the needed condition. It is shown that the film may be thinner than the rest value for times large compared with apparent relaxation times of the system. The results reconcile a number of experiments which had previously appeared contradictory. In addition, the theory is consistent with measurements of the convection speed of third sound and shows why previous efforts to explain the attenuation of third sound have failed. (auth)

34750 MEASUREMENTS OF ^{4}He VISCOSITY NEAR THE SUPERFLUID TRANSITION. Bruschi, L.; Mazzi, G.; Santini, M.; Torzo, G. (Univ., Padua). J. Low Temp. Phys.; 18: No. 5/6, 487-500(Mar 1975).

The ^{4}He viscosity has been measured with a vibrating wire viscometer on the superfluid side of the λ transition. The results indicate that η should be singular at T_λ, in agreement with the suggestion advanced recently by G. Ahlers. (auth)

34751 HEAT FLOW IN SUPERFLUID ^{3}He. Johnson, R. T.; Kleinberg, R. L.; Webb, R. A.; Wheatley, J. C. (Univ. of California, San Diego, La Jolla). J. Low Temp. Phys.; 18: No. 5/6, 501-517(Mar 1975).

The thermal resistance in both superfluid phases of ^{3}He has been measured at 20.0 and 29.6 bar in zero magnetic field. Heat conduction in ^{3}He-B is shown to be primarily hydrodynamic, and a regime of reproducible heat flow behavior in the A phase is reported. The viscosity of each phase as a function of temperature is calculated using an equation of the two-fluid model, and critical velocity effects are discussed. (auth)

34752 SUPERFLUID DENSITY IN ^{3}He FROM WEAK COUPLING THEORY. Combescot, R. (Cornell Univ., Ithaca, NY). J. Low Temp. Phys.; 18: No. 5/6, 537-542(Mar 1975).

The superfluid density tensor in ^{3}He is studied, from the weak coupling theory, assuming that the A phase is the axial state and the B phase the isotropic state. The results could explain why the A–B transition has not been seen in fourth-sound experiments. (auth)

34753 THERMAL BEHAVIOR OF ORDERED LIQUID HELIUM-3. Goldstein, L. (Los Alamos Scientific Lab., NM). J. Low Temp. Phys.; 18: No. 5/6, 543-547(Mar 1975).

Heat capacity and phase-boundary line data on very low-temperature liquid ^{3}He lead one to predict the thermally anomalous higher temperature liquid to become of normal thermal behavior over a limited pressure and temperature range of its ordered B phase. Well below the phase boundary temperatures, this ordered phase may become thermally anomalous again. If confirmed experimentally, this alternation in thermal behavior may point toward the respective dominance of two groups of thermal excitations over the indicated temperature ranges, a situation realized in liquid ^{4}He II. (auth)

34754 QUANTUM STATISTICAL MECHANICAL EQUATIONS FOR INHOMOGENEOUS FLUIDS. Buchan, G. D. (Univ. of Aberdeen, Eng.). J. Phys., A (London); 8: No. 1, 46-55(Jan 1975).

By adaptation and extension of the Brout-Nauenberg quantum surface tension theory (Brout, R. and Nauenberg, M., Phys. Rev.; 112: 1451-5 (1958)), exact quantum statistical mechanical equations for inhomogeneous fluid regions are derived. For free helium surfaces and the ^{3}He–^{4}He interface in the zero-pressure ground state, the equation appears as an analogue of the classical first BBGKY equation, in integral form. For thin films, a similar equation is derived containing a wall potential term. Such equations could be used to determine parameters relevant to the variation of the number density, or the z component of the kinetic energy density, with the normal coordinate z. Excited states and their ensemble averages are also considered and a quantum analogue of the classical virial equation of state is derived. (auth)

34755 CRITICAL VELOCITIES IN THE FLOW OF LIQUID HELIUM II BETWEEN ROTATING CYLINDERS. Devaraj, N. (Bangalore Univ., India). Indian J. Phys.; 48: No. 8, 748-750 (Aug 1974).

The critical velocities in the flow of liquid helium II between coaxial rotating cylinders measured by Devaraj & Hollis Hallett (1972) are compared with those of an earlier investigation by Heikkila & Hollis Hallett (1955), in view of the fact that the two sets of results are significantly different. (auth)

34756 VORTICITY GENERATED NEAR A FIELD EMITTER IN SUPERFLUID HELIUM. McClintock, P. V. E.; Phillips, A. (Lancaster Univ. (UK)). Phys. Lett., A; 50: No. 6, 417-418 (13 Jan 1975).

The density of vorticity near a field emitter in superfluid helium is estimated, and the implications for experiments which employ field emission characteristics to detect the appearance of a single nearby vortex in a rotating vessel are discussed. (auth)

34757 ATTENUATION AND DISPERSION OF FIRST SOUND IN A 19.4% ^{3}He–^{4}He MIXTURE NEAR THE LAMBDA-TRANSITION. Buchal, C.; Pobell, F. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Festkoerperforschung); Thomlinson, W. C. (Brookhaven National Lab., Upton, N. Y. (USA)). Phys. Lett., A; 51: No. 1, 19-20(27 Jan 1975).

Attenuation α and dispersion $D = \mu(\omega) - \mu(0)$ of first sound have been measured in a 19.4% ^{3}He–^{4}He mixture for frequencies 2.25 kHz ≤ ω/2π ≤ 594 kHz, and at temperatures $1\ \mu K \leq |T - T_\lambda| \leq 10$ mK. They are interpreted as arising from a relaxation and a fluctuation process. (auth)

34758 PHYSICS OF VERY LOW TEMPERATURE. Ohtsuka, T. (Tohoku Univ., Sendai (Japan). Faculty of Science). Denki Gakkai Zasshi; 94: No. 5, 355-362(May 1974). (In Japanese).

Physics of very low temperature is reviewed. At very low tem-

perature, the specific heat of solid is reduced and approaches zero on account of quantum effects. Thus, very low temperature is useful to study the basic laws of physics. Superconductivity and superfluidity were observed at very low temperature. These are macroscopic quantum effects, and various theories have been developed for the explanation of these effects. The occupation of one quantum state by large amount of particles is called quantum condensation, which is realized at very low temperature. This is the cause of the macroscopic quantum effect, and the superfluidity of ^{4}He is considered to be this effect. For the explanation of the superconductivity, Bardeen, Cooper, Schriefer et al. proposed the formation of electron pairs which consist of two electrons with opposite direction of momentum and spin. The Meissner effect is also explained by pairing effect. The quantization of magnetic flux, when permanent current flowed through a superconducting ring, was experimentally observed. Superconducting current due to the phase difference between two superconducting substances was pointed out by Josephson. This phenomenon confirmed that superconducting state was the state of quantum condensation. The BCS theory also gives transition temperature of superconduction of materials. At present, materials with higher transition temperature are sought for the practical use of superconductivity. The phenomenon of second superconductivity is discussed briefly. (JA)

34759 CONTRIBUTION OF PARAMAGNONS TO THE FREE ENERGY OF ^{3}He. Larkin, A. I.; Mel'nikov, V. I. (Inst. of Theoretical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 20: No. 6, 173-174(20 Sep 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 20: No. 6, 386-389(20 Sep 1974).

The temperature dependence of the paramagnetic increment to the specific heat of normal He^3 was calculated and compared with experiment. The relative contribution of the paramagnons to the free energy of superfluid He^3 is estimated. (auth)

34760 TRANSMISSION OF HEATER GENERATED HIGH FREQUENCY PHONONS THROUGH A SAPPHIRE—He II BOUNDARY. Buck, J.; Lassmann, K.; Eisemenger, W. (Univ., Stuttgart). Phys. Lett.; 50A: No. 4, 279-280(16 Dec 1974).

A new method is reported to measure the absolute transmission coefficient through a solid–He II-boundary by determining absolutely the temperature amplitude of the second sound pulses in the liquid. (auth)

34761 VISCOSITY AND SOME RELATED PROPERTIES OF LIQUID ^{3}He AT THE MELTING CURVE BETWEEN 1 AND 100 mK. Alvesalo, T. A.; Collan, H. K.; Loponen, M. T.; Lounasmaa, O. V.; Veuro, M. C. (Helsinki Univ. of Tech., Otaniemi, Finland). J. Low Temp. Phys.; 19: No. 1/2, 1-37(Apr 1975).

The viscosity η of liquid ^{3}He has been measured along the melting curve from 1 to 100 mK by means of a vibrating wire viscometer. In the normal Fermi-liquid region $1/\eta T^2 = 1.17 - 3.10T$ is found, where η is in μP and T in K. At the transition temperature $T_A = 2.6$ mK a rapid decrease occurs in η_n, the viscosity of the normal component. Within 0.3 mK below T_A, η_n decreases to about 25% of η_A, but then becomes essentially constant. In the B phase η_n first decreases to 20% of η_A and then seems to increase below 1.4 mK. Data on ρ_n, the density of the normal component, are also presented in the A and B phases. The results show that viscous flow is accompanied by a flow of zero dissipation, thus proving superfluidity in the A and B phases. The viscosity data at magnetic fields up to 0.9T have been related to theoretical calculations of the energy gap of superfluid ^{3}He near T_A. The splitting of the A transition and the suppression of the B phase in an external field were also measured. (auth)

34762 STATISTICAL FLUCTUATIONS THEORY FOR HYSTERESIS OF PERSISTENT CURRENTS IN LIQUID HELIUM. Joselson, B. Z.; Revzen, M. (Technion–Israel Inst. of Tech., Haifa). J. Low Temp. Phys.; 19: No. 1/2, 125-143(Apr 1975).

A statistical theory is presented for the experimental appearance of critical velocities, hysteresis, and decay effects in persistent currents of liquid ^{4}He. The persistent superfluid current is assigned with a set of states of fluctuation, characterized by the values of a small number of thermodynamic variables. Any measured state of persistent current flow is regarded as a statistical expectation value of the states of fluctuation, each of which is weighted by its own thermodynamic probability, in a manner closely related to the statistical treatment of Brownian motion. A phenomenological description by either a heat loss function or a free energy function is obtained, depending on the detailed method chosen for the statistical averaging. (auth)

Superconductivity

Refer also to abstracts 33906–33909, 33935, 33951, 33952, 33959, 33969, and 34758.

34763 SUPERCONDUCTIVITY IN Pb UNDER PRESSURE. Vashishta, P. (Argonne National Lab., IL); Carbotte, J. P. J. Low Temp. Phys.; 18: No. 5/6, 457-466(Mar 1975).

Using the strong coupling theory, the deviations from the BCS laws are calculated for Pb under hydrostatic pressure. The strength of the electron–phonon coupling is reduced under pressure and this is manifested in the temperature variation of the reduced gap edge, dc Josephson current, and critical magnetic field, all of which tend toward the BCS values. (auth)

34764 SIMPLE MODEL FOR THE VORTEX CORE IN A TYPE II SUPERCONDUCTOR. Clem, J. R. (Ames Labs., Iowa). J. Low Temp. Phys.; 18: No. 5/6, 427-434(Mar 1975).

In order to model the core of an isolated vortex in a type-II superconductor, a variational trial function for the magnitude of the normalized order parameter of the form $f = \rho/R$ is assumed, where ρ is the radial coordinate, $R = (\rho^2 + \xi_v^2)^{1/2}$, and ξ_v is a variational core radius parameter. Remarkably simple analytic expressions for the magnetic flux density and supercurrent density that solve Ampere's law and the second Ginzburg–Landau equation are obtained. An analytic result for the free energy of the isolated vortex is then derived by integrating the Ginzburg–Landau free energy functional. The value of ξ_v that minimizes the free energy is calculated as a function of the Ginzburg–Landau parameter $\kappa = \lambda/\xi$ and is found to range from $\xi_v = 0.935\xi$ for $\kappa = 0.707$ to $\xi_v \approx 1.414\xi$ for $\kappa \gg 1$. A simple expression for the form factor or the Fourier transform of the flux density is obtained, which may be useful in the analysis of neutron diffraction experiments. (auth)

34765 PRESENT PROBLEMS OF SUPERCONDUCTIVITY. Buckel, W. pp 7-33 of Rheinisch-Westfaelische Akademie der Wissenschaften. Buckel, W.; Schilling, W. (eds.). Opladen, Ger.; Westdeutscher Verlag GmbH (1974). (In German).

A brief review, based on the Bardeen-Cooper-Schrieffer microscopic theory of superconductivity, is presented of the present understanding of this phenomenon. Possible practical applications of superconductivity are discussed. (JSR)

34766 VORTEX LATTICE ORIENTATION AND THE ANISOTROPY OF H_{c_2} IN TYPE II SUPERCONDUCTORS. Roger, M.; Kahn, R.; Delrieu, J. M. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Lett., 50A: No. 4, 291-293(16 Dec 1974).

In single crystals of pure or dirty superconductors the orientation of the vortex lattice is always related to the anisotropic properties of the conduction electrons, i.e., the anisotropy of H_{c_2} and not to the magnetic elastic strain interaction. (auth)

34767 THEORY OF SUPERCONDUCTIVITY WITHOUT SOLUTION OF MANY BODY PROBLEMS. Forehlich, H. (Univ. of Salford, Eng.). Collect. Phenomena; 1: No. 4, 173-184(Jul 1974).

An exact equation of motion for the bilocal macroscopic wavefunction $\Phi_2(x,y)$ can be established with the help of the exact equation satisfied by the second reduced density matrix. This leads to general conditions involving the phase of Φ_2 from which conclusions can be drawn without explicit solution. The London equation for stationary conditions arises as a limiting case. In equilibrium the connection of Φ_2 with the bulk of electrons is governed by parameters which can be used to classify states. The equation of motion then yields the standard BCS theory without requiring solutions of a microscopic problem. (auth)

34768 CONTACT RESISTANCE AS A MEASURE OF THE SUPERCONDUCTING ORDER PARAMETER. Chien, M. K. (Case Western Reserve Univ., Cleveland); Farrell, D. E. J. Low Temp. Phys.; 19: No. 1/2, 75-82(Apr 1975).

It was shown experimentally that the electrical contact resistance between a thin copper wire and a bulk superconductor contains a small contribution that varies with temperature below T_c. The observed temperature dependence is always close to that of the energy gap in the superconductor. (auth)

34769 COMPARISON OF MECHANISMS OF PLASTICITY ENHANCEMENT AT THE SUPERCONDUCTING TRANSITION. Indenbom, V. L.; Estrin, Yu. Z. (Inst. of Crystallography, Moscow). J. Low Temp. Phys.; 19: No. 1/2, 83-97(Apr 1975).

The mechanisms of the plasticity enhancement at the N–S transition are considered, based on a comparison of the dependence of this effect on the concentration of defects limiting the dislocation mobility, which, as is shown, is different for competing dynamic models. A method is suggested for determining the role of quasistatic effects, arising due to the inhomogeneity of the dislocation structure of superconductors, in the plasticity enhancement at the N–S transition. (auth)

34770 INTERMEDIATE STATE IN SUPERCONDUCTING MERCURY. Farrell, D. E. (Univ. of Southern California, Los Angeles); Huebener, R. P.; Kampwirth, R. T. J. Low Temp. Phys.; 19: No. 1/2, 99-112(Apr 1975).

Using the magneto-optic technique, an extensive study has been made of the intermediate state in single crystals of superconducting mercury. A regular laminar structure, closely approaching that envisaged by Landau, was realized in the thinnest sample examined (47 μm). The field dependence of the lamina periodicity displays excellent agreement with the Landau model and the deduced surface energy is in good agreement with the Ginzburg–Landau theory. At applied magnetic fields very close to the critical one, the stable magnetic structure consists of isolated superconducting filaments. A number of observations are reported on their growth and stability. (auth)

34771 WEAK-COUPLING THEORY OF SUPERCONDUCTING MAGNETIC ALLOYS. Lam, J. (Dikewood Corp., Albuquerque, NM). J. Low Temp. Phys.; 19: No. 1/2, 113-124(Apr 1975).

The interaction of electrons with magnetic impurities in superconducting magnetic alloys is calculated to second order in the spin exchange coupling. Its effect on the transition temperature, the order parameter, the density of states, and the conductance are studied. The results are as follows: (1) The variation of the transition temperature with impurity concentration is the same as in the Abrikosov–Gor'kov theory; that of the order parameter is similar. (2) The density of states is finite at all nonzero impurity concentrations. Superconductivity with magnetic impurities is always gapless. (3) There are far more states about the Fermi level than in the Abrikosov–Gor'kov theory. At an impurity concentration equal to two-thirds its critical value, the density of states at the Fermi level surpasses one-half the normal value. The conductance curve loses all semblance of an energy gap. (auth)

34772 NONLINEAR EFFECTS IN THE JOSEPHSON PLASMA RESONANCE. Dahm, A. J. (Case Western Reserve Univ., Cleveland); Langenberg, D. N. J. Low Temp. Phys.; 19: No. 1/2, 145-167(Apr 1975).

Experimental and theoretical studies are reported of the stability of the zero-voltage state of Josephson tunnel junctions in the simultaneous presence of dc bias current and rf field at a frequency comparable to the Josephson plasma frequency. The observations can be qualitatively understood in terms of large-amplitude parametric excitation of the plasma mode at fractional harmonics of the plasma frequency. The quasiparticle-pair interference or cos ϕ current appears to play a significant role in the observed phenomena. Comments are made on nonlinear phenomena in the longitudinal nuclear magnetic resonance in superfluid ^{3}He A on the basis of a previously proposed analogy between the two systems. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 33992, 34629, 34845, 34961, and 35039.

34773 (AECL-4931, p 61) SLOW-NEUTRON MULTIPLE SCATTERING IN LIQUID He. Sears, V. F. Oct 1974.
In Physics Division progress report, July 1 to September 30, 1974.

34774 (CONF-750303-15) SURVEY OF COMPUTER CODES WHICH PRODUCE MULTIGROUP DATA FROM ENDF/B-IV. Greene, N. M. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). [nd]. 7p. Dep. NTIS $4.00.
From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).
The features of three code systems that produce multigroup neutron data are contrasted. This includes the ETOE-2/MC^2-2/SDX, MINX/SPHINX, and AMPX code packages. These systems all contain a fairly extensive set of processing capabilities with the current evaluated nuclear data files—ENDF/B. They were designed with different goals and applications in mind. This paper discusses some of their differences and the implications for particular situations. (auth)

34775 (CONF-750303-35) COMPARISON OF VIM AND MC^2-2: TWO DETAILED SOLUTIONS OF THE NEUTRON SLOWING-DOWN PROBLEM. Prael, R. E.; Henryson, H. II. (Argonne National Lab., Ill. (USA)). Mar 1975. Contract W-31-109-Eng-38. 6p. Dep. NTIS $4.00.
From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).
A comparison of solutions by the Monte Carlo code VIM and by ETOE-2/MC^2-2 of a zero-dimensional slowing-down problem in the homogeneous ZPR-6 Assembly 7 core composition demonstrates the ability of either code to provide a reliable computational benchmark capability for such calculations. (16 tables) (auth)

34776 (IAE-2340) NEUTRON TRANSPORT IN MEDIA WITH CHANGING PARAMETERS. I. Existence and Uniqueness of Generalized Solutions. Novikov, V. M.; Shikhov, S. B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 24p. (In Russian). Dep. NTIS (US Sales Only) $4.25.
The neutron transport kinetic equation with any finite number of delayed neutron groups is considered under conditions of arbitrary physically permissible changes of medium parameters. General functional properties of transport equation coefficients are discussed. It is shown that classical (i.e., time-differentiable) solutions do not, generally speaking, exist in L_p spaces. Two possible modifications of generalized (i.e., non-classical) solutions, solutions on characteristics and solutions generalized in the sense of Sobolev (distributions) are defined. Existence and uniqueness of generalized solutions are proved. The evolution operator of the system is constructed in a form of a series which converges in uniform operator topology and is strongly continuous. (2 figures) (auth)

34777 (JAERI-M-5767) A BASIC STUDY ON THE ADJUSTMENT OF GROUP CROSS SECTIONS BY MEANS OF INTEGRAL DATA. Mitani, H. (Japan Atomic Energy Research Inst., Tokyo). Jul 1974. 110p. (In Japanese). INIS.
Theoretical and numerical studies have been made on the adjustment of group cross sections by means of the integral data such as critical mass, reaction rate ratio and sample worth ratio obtained from fast critical experiments, to see usefulness of the method. The theoretical basis for the adjustment of group cross sections is established by use of the generalized method of least squares. In the adjusting process, information of the integral data is thus used to supplement the nuclear data. A theory of the correlation between group cross sections is derived; which permits reasonable adjustment of the group cross sections in nuclear physics. It is confirmed theoretically and proved numerically that the sum of squares of the residual in the least-square treatment has a non-central chi-square distribution when the group cross sections include systematic error. The χ^2-test is proposed as a criterion for the validity of the adjusting process. Numerical study is made of the ABBN set, using the integral data obtained from ZPR-III, ZEBRA, VERA and FCA. Some practical problems are investigated, including the effect of the correlation between group cross sections and also the arbitrariness in the standard deviation of nuclear data on the adjusting process. The adjusted ABBN set is compared with differential cross section and other evaluated data, and the estimation of a critical mass by the adjusted results is also made. The adjustment of group cross sections by integral data is highly useful. (auth)

34778 (ORNL-TM-4550) CRITICAL EXPERIMENTS AND THE 2200 M/SEC NEUTRON PARAMETERS. Gwin, R. (Oak Ridge National Lab., Tenn. (USA)). Jan 1975. Contract W-7405-eng-26. 13p. Dep. NTIS $4.00.
The use of critical volumes of aqueous homogeneous solutions of uranium in constraining the 2200 m/sec neutron parameters for ENDF/B has been examined. The 2200 m/sec parameters for ^{233}U and ^{235}U are constrained by relating $(\bar{\eta} - 1)\bar{\sigma}_{ax}$ to constant K obtained from the analysis of the critical systems. As presently used K is directly proportional to the hydrogen capture cross section at 2200 m/sec. This paper suggests that the capture cross section hydrogen be removed from K and that a new constant K/σ_{aH} be defined by the critical systems. (auth)

34779 FAST NEUTRON SPECTRA IN REACTOR MATERIALS. II. Analysis. Nishihara, H.; Kanazawa, S.; Miki, K.; Nakajima, H. (Kyoto Univ. (Japan). Faculty of Engineering); Kimura, I. pp 210-219 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese).
From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).
The energy spectra of fast and medium energy neutron have been analysed for the purposes of obtaining weighted spectra for producing multigroup constants, analysis of spectrum formation mechanism in a fast reactor, calculation of shielding and transport of fast neutrons, spectrum analysis of continuous slowing down theory, analysis of time dependent neutron energy spectra, and analysis of neutron spectrum by the time of flight (TOF) method. An attempt is made to analyse the TOF energy spectrum and the spatial distribution of neutrons in a thorium oxide assembly and compare with the result of multigroup analysis. Analysis of the experimental results with an iron and aluminum oxide assemblies was carried out in advance to investigate the method of measurement and analysis. Seventy and twenty-five group constants were made for ^{232}Th from data of ENDF/B-2. One dimensional spherical symmetry calculation with DTF-IV was made for the analysis. Result of ANISN was also used for the analysis of the iron assembly. The used group constant sets were ABBN and JAERI-FAST, (and JAERI-M4927 for ^{232}Th). The set of RSIC DLC-2/99G was also used for iron. The assumption of spherical symmetry was confirmed by the measurement of spatial distribution. Fast neutrons were generated with an electron linear accelerator. Comparison of experimental results and calculation for the iron assembly shows that the ABBN spectrum was in good agreement with measurement. Agreement with the experiment was also seen in the ABBN spectrum for aluminum oxide. The experimental results for the thorium oxide assembly was compared with the ABBN and the JAERI-FAST-70G spectra. The JAERI-M4927 group constants seemed to be suitable. (JA)

34780 FAST NEUTRON SPECTRA IN REACTOR MATERIALS. I. Experiment. Kimura, I.; Kobayashi, K.; Hayashi, S. A.; Yamamoto, S. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Nishihara, H. pp 200-209 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese).
From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).
Fast neutron spectra in reactor materials were measured by using an electron linear accelerator and a time-of-flight spectrometer. The materials used for the experiment were iron, aluminum oxide, and thorium oxide. The dimensions of an iron assembly was 90 cm width, 1 m depth and 1 m height. The electron beam from the linear accelerator irradiated a water-cooled lead target at the center of the assembly and produced photoneutrons. Aluminum oxide and thorium oxide were put into spherical vessels made of stainless steel with diameter of 60 cm. The lead targets were also placed at the center. Fast neutron flux was measured with a nickel wire and the distribution of epithermal neutrons and bremsstrahlung was determined with a gold wire. The detectors for the time of flight measurement were ^{6}Li glass scintillators, ^{10}B-vaseline–NaI(Tl) counter and a liquid scintillator. Background due to gamma rays was negligible. The energy distribution was calculated from the observed time spectra by using an ALGOL code. Spatial distributions of neutron flux and x ray were obtained, the spherically symmetric distribution of the neutron flux was observed, and the observed neutron spectra are shown. The spec-

trum in the iron assembly can be compared with theoretical calculation. In the spectra in aluminum oxide and thorium oxide, systematic error occurred due to leakage of neutrons. Further investigation is required. (JA)

34781 CALCULATION OF FAST NEUTRON TRANSPORT IN GRAPHITE, IRON, AND SODIUM. Takeuchi, K. (Ship Research Inst., Tokyo (Japan)); Miyasaka, S. pp 228-237 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese).

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jan 1973).

Calculation of fast neutron transport in graphite, iron, and sodium was carried out by using four computer codes, PALLAS code, ANISN code, Monte Carlo code 05R, and Multigroup Monte Carlo code MORSE. The data on graphite used for analysis was the neutron angular spectrum measured by Profio et al. The calculation was made with a spherical model. The calculation was repeated by correcting energy spectrum until calculated leakage neutron spectrum coincides with the experimental one. Calculated results by the PALLAS and the ANISN codes were mostly in good agreement with the experimental result. The data on iron used for analysis was taken by Malaviya et al. with a linear accelerator. The calculation of neutron angular spectra was performed with a spherical model. Large differences between experimental and calculated results were seen in the energy range from 400 to 600 keV. Sharp peaks were seen in the experimental spectrum, while only a deep valley around 400 keV was seen in the calculated spectrum. The value of 25 keV peak by PALLAS was larger than the measured value, and the position of the peak by ANISN shifted to the high energy side. Calculation of penetrated neutron spectrum is in progress, and comparison with the data by Maerker et al., will be made. Calculation by the Monte Carlo codes 05R and MORSE was also made, and values were compared with experimental results. Agreement between measured spectra and calculated spectra in iron and graphite systems was good as a whole. (JA)

34782 EFFECTS ON FAST NEUTRON SPECTRA DUE TO ANISOTROPIC SCATTERING IN THE CENTER OF MASS SYSTEM. Yamamura, Y. (Okayama Coll. of Science (Japan)); Yoshida, K.; Yamamoto, K.; Sekiya, T. pp 220-227 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese).

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

A method to express fast neutron spectra with Wigner type analytical solution by combining continuous slowing down (CSD) method and approximate scattering kernel method is described. A slowing down parameter $\xi(u)$ was defined from a slowing down equation in an infinite homogeneous system. The approximate scattering kernel was introduced regarding elastic scattering. For inelastic scattering, a single level approximation was used in the resolved region, and an evaporation model was used in the unresolved region. The anisotropic lth order approximate scattering kernels in the laboratory system were obtained. Then, the slowing down parameter and collision density were calculated. For an iron assembly, the scattering of neutrons was anisotropic down to several keV in the center of mass system, and this effect was large. The effect of this anisotropic scattering must be taken into account for fast reactor systems, since the system consists of heavy nuclides. (JA)

34783 APPLICATIONS OF METHODS AND RESULTS OF NEUTRON DIFFRACTION BY VIBRATING SINGLE CRYSTALS. Petrzilka, V. (Karlova Universita, Prague (Czechoslovakia). Fakulta Matematicko-Fyzikalni); Michalec, R.; Chalupa, B.; Sedlakova, L.; Mikula, P.; Cech, J. (Nuclear Physics Institute, Prague-Rez, Czechoslovakia). Nucl. Instrum. Methods; 123: No. 2, 353-361(15 Jan 1975).

Possibilities of application of phenomena observed in the course of investigations concerning diffraction of neutrons by vibrating lattices of single crystals are described. (auth)

34784 MONTE CARLO CALCULATION OF MULTIPLE SCATTERING EFFECTS IN THERMAL NEUTRON SCATTERING EXPERIMENTS: MODIFICATION TOSLAB GEOMETRY. Copley, J. R. D. (Argonne National Lab., Ill. (USA)). Comput. Phys. Commun.; 9: No. 1, 59-63(Jan 1975).

This paper describes a modification of the program "SLOW NEUTRON MULTIPLE SCATTERING" which is a Monte Carlo code to calculate multiple neutron scattering effects in a target consisting of a series of cylinders with axes normal to the scattering plane. The present version treats the scattering from a plane slab target. The Monte Carlo code is based on that of Bischoff, who described programs which treat both slab geometry and multiple vertical cylinder geometry. (auth)

34785 MONTE CARLO CALCULATION OF MULTIPLE SCATTERING EFFECTS IN THERMAL NEUTRON SCATTERING EXPERIMENTS: MODIFICATION TO HORIZONTAL CYLINDER GEOMETRY. Copley, J. R. D. (Argonne National Lab., Ill. (USA)). Comput. Phys. Commun.; 9: No. 1, 64-68(Jan 1975).

A Monte Carlo program which is a modified version of the code due to Bischoff, has recently been described. That program was written to calculate multiple neutron scattering effects in a target consisting of a series of cylinders with axes normal to the scattering plane. In the present paper a modification is described which permits the user to calculate multiple scattering effects in a target consisting of a series of cylinders with axes parallel to the scattering plane. (auth)

34786 SLOW-NEUTRON MULTIPLE SCATTERING IN LIQUID HELIUM. Sears, V. F. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Nucl. Instrum. Methods; 123: No. 3, 521-527(1 Feb 1975).

The use of a semi-analytic method for making multiple scattering corrections in slow-neutron scattering work is illustrated by applying the method to a detailed calculation of the multiple scattering in liquid helium. It is assumed that the liquid helium sample is contained in a cylindrical cassette which is partitioned with absorbing spacers and the calculations are performed for conditions appropriate to triple-axis crystal spectrometry at Chalk River Nuclear Laboratories. (auth)

34787 THEORY OF NUCLEAR AND MAGNETIC NEUTRON SMALL ANGLE SCATTERING AT DISLOCATIONS IN ANISOTROPIC CUBIC CRYSTALS. Schmatz, W.; Dederichs, P. H.; Scheuer, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung). Z. Phys.; 270: No. 4, 337-341(Nov 1974).

An analytic expression for the dilatation and the stress tensor in reciprocal space due to dislocations in anisotropic cubic crystals is deduced. From this, absolute values of nuclear and magnetic small angle scattering cross sections are calculated. For Cu and Ni they differ considerably from the values calculated with the assumption of elastic isotropy. The new presentation of scattering theory allows further the discussion of the interference in scattering between dislocations in a dislocation network. (auth)

34788 INTERPRETATION OF GOLD SHELL TRANSMISSION DATA MEASURED WITH 24 keV NEUTRONS. Frohner, F. H. (NEA Neutron Data Compilation Centre, Gif-sur-Yvette, France). Ann. Nucl. Sci. Eng.; 1: No. 9/10, 519(Sep 1974).

Attention is drawn to, and brief discussion is given of a misinterpretation of a result of the author's work made by T. T. Semler [J. Nucl. Energy, 27: 185(1973)] in a recent study of the effects on multiple spin species on spherical shell neutron transmission data. (UK)

34789 UNIFORM ASYMPTOTIC EXPANSIONS IN TRANSPORT THEORY WITH SMALL MEAN FREE PATHS, AND THE DIFFUSION APPROXIMATION. Habetler, G. J. (Rensselaer Polytechnic Inst., Troy, NY); Matkowsky, B. J. J. Math. Phys. (N. Y.); 16: No. 4, 846-854(Apr 1975).

Initial-boundary value and boundary value problems are considered for transport equations in inhomogeneous media. The case when the mean free path is small compared to typical lengths in the domain (e.g., the size of a reactor) is considered. Employing the boundary layer technique of matched asymptotic expansions, one derives a uniform asymptotic expansion of the solution of the problem. In so doing it is found in the interior of the domain, i.e., away from boundaries and away from the initial line, the leading term of the expansion satisfies a diffusion equation which is the basis of most computational work in reactor design. One also derives boundary conditions appropriate to the diffusion equation. Comparisons with existing results such as the asymptotic and P_1 diffusion theories, the P_N approximation, and the extrapolated end point condition for these approximations are made. Finally the uniform validity of the expansions is proved, thus yielding the desired error estimates. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 33271, 34610, and 34807.

34790 (IPNO-T-74-01) THEORETICAL CONTRIBUTION TO NUCLEON–DEUTERON SCATTERING AT INTERMEDIATE ENERGY: ANALYSIS OF THE OFF-ENERGY SHELL NUCLEON–NUCLEON INTERACTION; INTERPRETATION OF THE p + d →

p + p + n EXPERIMENTS AT 155 MeV. L'Huillier, Marcelle. (Paris-11 Univ., 91 – Orsay (France). Div. de Physique Theorique; Paris-7 Univ., 75 (France)). 1974. 129p. (In French). INIS.

Off-energy shell T(q,p;k) matrix elements are calculated using realistic local two-nucleon potentials with soft or hard cores (Hamada–Johnston, Reid, Pires–Gogny–de Tourreil, de Tourreil–Sprung). These potentials are not phase-shift equivalent and display large differences for the highest momenta, which are related to the short-range behavior of the potentials. Similar differences are found in the off-shell results. D(p,2p)n and D(p,pn)p experiments at 155 MeV are analyzed in the framework of a double scattering mechanism with the previous considered potentials. The cross-sections measured at Orsay are reproduced qualitatively. A pretty good fit is obtained whenever a quasi-free scattering occurs; the agreement is poorer near a final-state interaction kinematical condition and varies with kinematics. Consequently, despite the sensitivity of the calculation to the NN potentials used, clear information on the potentials off the energy shell is not obtained. The higher-order contributions of the multiple scattering processes are estimated from a fixed scatterer approximation using a model S-wave central separable NN interaction. In this FSA model, the double scattering approximation appears to be unjustified, while the amplitude obtained from the solution of a Faddeev-type integral equation gives account of the observed experimental trends. (FR)

34791 (PTB-ND-7) NEUTRON YIELDS FROM ^{7}Li(p,n)^{7}Be, ^{51}V(p,n)^{51}Cr, D(d,n)^{3}He AND T(p,n)^{3}He REACTIONS. Leung, M. K. (Physikalisch-Technische Bundesanstalt, Braunschweig (F. R. Germany). Neutronendosimetrie). Mar 1974. 33p. Dep. NTIS (US Sales Only) $4.75.

This report gives a survey on neutron yields from different nuclear reactions. These reactions will be utilized to produce monoenergetic neutrons by means of the PTB accelerator installation. (14 figures, 2 tables) (auth)

34792 CONTRIBUTION OF MESONIC-EXCHANGE EFFECTS TO THE PHOTOPRODUCTION OF CHARGED PIONS ON ^{3}He NUCLEI. Lazard, C. (Institut de Physique Nucleaire, Orsay, France); Maric, Z.; Popovic, M. B.; Zivanovic, D. Lett. Nuovo Cim.; 12: No. 11, 405-409(15 Mar 1975).

In order to study the mesonic-exchange effects in a reaction which involves electromagnetic radiation, the reaction $\gamma + {}^{3}He \rightarrow \pi^{+} + {}^{3}H$ in the region of the first pion–nucleon resonance where the magnetic-dipole transition is dominating is studied. The differential cross sections are plotted. (JFP)

34793 BINDING ENERGY OF ^{3}He. Dhara, M. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys.; 48: No. 8, 690-702(Aug 1974).

The bound state of p–p–n is considered by using Faddeev's nonrelativistic three-particle system. Faddeev's equations are solved with only the s wave in the two-body partial-wave expansion being kept. The binding energy of ^{3}He was calculated on the assumption that the interaction between the nucleons is described by a nonlocal potential with separable variable. The Coulomb effect is also accounted for by the use of the Coulomb-modified variable. (auth)

34794 EMISSION OF NEUTRONS FROM THICK TARGETS DURING BOMBARDMENT BY PROTONS AND DEUTERONS. Akabirov, B., Abibullaev, N.; Golyamov, M.; Islamov, B. I.; Muminov, V. A. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 8, 24-26(1974). (In Russian).

The energy spectra and angular distribution of neutrons formed by the bombardment of Be targets with 18-MeV protons and 15-MeV deuterons were measured. The fast neutron yield in the forward hemisphere was determined for various angles and the results were compared with those obtained by other investigators. (JSR)

34795 POSSIBLE INFLUENCE OF GROUND STATE BARYONIC RESONANCE ADMIXTURE ON THE YIELD OF THE ^{4}He(γ,p)T REACTION. Laget, J. M. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Dept. de Physique Nucleaire). Phys. Lett., B; 55: No. 1, 37-40(20 Jan 1975).

The inclusion of a reasonable amount of N' (1470) in the ^{4}He ground state is consistent with the available experimental cross section values of the ^{4}He(γ,p)T reaction for intermediate energy photons ($E_{\gamma} < 400$ MeV). (auth)

34796 THE ^{2}H(n,np)n REACTION AT 130 MeV. Differential Cross Sections from Kinematically Complete Data Over a Wide Range of Phase Space. McNaughton, M. W.; Griffiths, R. J. (King's Coll., London (UK)); Blair, I. M. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment); Bonner, B. E. (California Univ., Davis (USA). Crocker Nuclear Lab.); Edgington, J. A.; May, M. P. (Queen Mary Coll., London (UK)); Stewart, N. M. (Bedford Coll., London (UK)). Nucl. Phys., A; 239: No. 1, 29-44(17 Feb 1975).

Kinematically complete data are presented from the ^{2}H(n,np)n reaction at 130 MeV. The data, in the form of third differential cross sections, cover 40 pairs of final-state angles and final-state energies ranging from 1 to 100 MeV. The n–n and n–p final state interactions and n–p quasi-free scattering processes are observed in various regions of phase space over a wide range of kinematic conditions. The gross features of the data are reproduced by a simple model based on the simple impulse approximation and the Watson–Migdal model, and a value for the neutron–neutron scattering length, $a_{nn} = -17.1 \pm 0.8$ fm, is extracted from one pair of angles using this model. The fit to the quasi-free scattering data produced by the simple impulse approximation is unsatisfactory, however, and requires further investigation. No attempt has yet been made to apply more sophisticated three-body models to these higher energy data. (auth)

34797 REACTIONS ^{2}H(d,p)^{3}H AND ^{2}H(d,n)^{3}He BELOW 150 keV. Pospiech, G.; Genz, H.; Marlinghaus, E. H.; Richter, A.; Schrieder, G. (Bochum Univ. (F.R. Germany). Inst. fuer Experimentalphysik). Nucl. Phys., A; 239: No. 1, 125-133(17 Feb 1975).

Relative differential cross sections have been measured for the ^{2}H(d,p)^{3}H and ^{2}H(d,n)^{3}He reactions from 70 keV $\leq E_d \leq$ 150 keV with thin deuterated polyethylene foils on carbon in order to search for a resonance near the d–d threshold in ^{4}He. The energy dependence of anisotropy coefficients from the expansion of the c.m. angular distributions in terms of even Legendre polynomials shows no resonance-like behavior. The importance of multiple scattering effects and energy loss on these coefficients is pointed out when thick targets are used. (auth)

34798 THE MAGNETIC FORM FACTORS OF ^{3}He AND ^{3}H WITH MESONIC-EXCHANGE CORRECTIONS. Effects of the D-State and the Role of Short-Range Correlations. Barroso, A. (Sussex Univ., Brighton (UK). School of Mathematical and Physical Sciences); Hadjimichael, E. (Fairfield Univ., Conn. (USA)). Nucl. Phys., A; 238: No. 3, 422-436(10 Feb 1975).

It is shown that the D-state of the trinucleon and the short-range behavior of the S- and D-state wave functions are extremely important in determining the magnetic form factors of the three-body system. A complete calculation of the form factors is presented taking into account the conventional impulse approximation for the nuclear current and contributions from mesonic exchange currents. The D-state wave function has been determined by perturbation theory. (auth)

34799 OSCILLATOR BASE FOR FOUR-PARTICLE SYSTEMS. Macharadze, T. S.; Bartaya, O. L. pp 56-72 of Issledovaniya po teorii struktury legkikh yader. Dzhibuti, R. I. (ed.). Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

A method is proposed for the construction of an oscillator basis and it is applied to a system consisting of four particles. (JSR)

34800 TRANSFORM COEFFICIENTS IN THE HYPERSPHERICAL APPROACH TO THE PROBLEM OF FOUR BODIES WITH UNEQUAL MASS. Dzhibuti, R. I.; Tomchinskii, V. Yu.; Shubitidze, N. I. pp 73-84 of Issledovaniya po Teorii Struktury Legkikh Yader. Dzhibuti, R. I. (ed.). Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

A method is given for the application of the K harmonic method to a system of four particles with unequal masses. In the approximation of the minimum harmonic a unitary transformation was obtained by generalization of the Raynal-Revai transforms to the case of four nonidentical particles. The corresponding transform coefficients were calculated analytically. (JSR)

34801 THREE-NUCLEON BOUND STATES AND PHENOMENOLOGICAL POTENTIALS. Verhanovitz, R. F. Bethlehem, PA; Lehigh Univ. (1974). 199p. University Microfilms Order No. 75-4743.

Thesis (Ph. D.).

The three-nucleon bound states are investigated within the framework of nonrelativistic quantum mechanics. Three different types of charge symmetric phenomenological potentials are used for the nuclear interaction; one has a hard core, the second is velocity dependent, and the third is non-local. The calculated binding energies of the mirror nuclei ^{3}H and ^{3}He are found to depend very little on the form of the potential used. The values of these calculated binding energies are all slightly larger than the experimental ones. The charge form factors are also calculated for these three-body mirror nuclei. The results are insensitive to the form of the potential used. That nuclear forces are not

charge symmetric is rejected; instead, a modification of the Coulomb operator to allow for a plausible amount of polarization of the nucleons is made. The velocity-dependent and hard-core potential calculations for the three-nucleon system are carried out by using the S and S' states in the three-nucleon wave function. The three-nucleon Schrödinger equation is reduced to two differential equations by repeated application of the independent pair method. The inclusion of the tensor potential in the three-nucleon calculations leads to a system of coupled partial differential equations that can not be solved by any practicable means. (RWR)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 34251, 34618, 34666, 34791, 34836, 34986, 34987, 35014, and 35022.

34802 (AED-CONF-74-042-022) INTERFERENCE PROCESSES IN DIRECT HEAVY-ION REACTIONS. Kohlmeyer, B.; Schneider, W. F. W.; Puehlhofer, F.; Pfeffer, W.; Stock, R.; Bohlen, H. G.; Bock, R. (Marburg Univ. (F. R. Germany). Fachbereich Physik). 1974. 20p. (In German). INIS.

From spring meeting of the expert committee on nuclear and high-energy physics of the Deutsche Physikalische Gesellschaft e.V.; Bochum, F. R. Germany (4 Mar 1974).

Measured oscillating effective cross sections in the angular distributions of direct heavy-ion reactions ($^{12}C(^{16}O, ^{16}O)^{12}C$, $^{14}C(^{16}O, ^{16}O)^{14}C$, $^{14}C(^{16}O, ^{15}N)^{15}N$, $^{30}Si(^{32}S, ^{31}P)^{31}P$, $^{30}Si(^{32}S, ^{32}S)^{30}Si$) with slight nucleon difference are traced back to interfering transfer processes. The influence of a second amplitude is investigated which is brought about by the transfer of the mass difference. With this, the characteristic structures in the angular distributions of the elastic, inelastic and competing transfer can be consistently described. (GE)

34803 (JINR-E1-8248) MECHANISM OF FAST HELIUM AND TRITIUM PRODUCTION BY 665 MeV/PROTONS ON LIGHT NUCLEI. Komarov, V. I.; Molokanov, A. G.; Reshetnikov, G. P.; Savchenko, O. V.; Tesh, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 27p. Dep. NTIS (US Sales Only) $4.50.

The process of fast ^{3}He, ^{3}H and ^{4}He production at small angles by 665 MeV protons on light nuclei is discussed. It is shown, that the experimental data of spectra of ^{3}He, ^{3}H and ^{4}He fragments with energy ≥350 MeV are compatible with the assumption of the dominating role of two reaction channels: Quasielastic scattering and pion production on clusters. (auth)

34804 (JINR-P4-8526) ENERGIES AND CHARGE FORM FACTORS OF THE CARBON NUCLEUS WITH RADIAL OSCILLATIONS OF ALPHA CLUSTERS TAKEN INTO ACCOUNT. Kinchakov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 14p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

By the method of generator coordinates with the Volkov and Brink–Boeker effective nucleon–nucleon forces, with radial oscillations of alpha clusters taken into account, energies of rotational states of the nucleus ^{12}C were calculated. This method, which takes radial oscillations into account, reduces the binding energy of the carbon nucleus and improves the agreement of the calculated spectrum with experiment. The influence of radial oscillations of alpha clusters on the charge form factor of elastic electron scattering was shown. (3 figures, 2 tables) (auth)

34805 (NP-20317) RESONANCE PROPERTIES IN THE INTERVAL $4.1 < E_p < 6.1$ MeV FROM (p,p) AND ($\vec{p}$,p) REACTIONS ON ^{16}O. Salgado, R. A. (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ciencias). 1974. 65p. (In Spanish). Dep. NTIS (US Sales Only) $6.25.

Thesis.

The variation with incident energy and emergent angle of the elastic cross sections for protons and polarized protons was measured in order to assign spin, parity, and isospin to the resonances observed in the energy region $4.1 < E_p < 6.1$ MeV. From the assignment of intrinsic properties and from the 13 resonances observed in ^{17}F (four of which are isobaric analogs of the states at $E_x = 4.583$ MeV ($J = 3/2^-$), 5.086 ($1/2^-$), 5.460 ($1/2^+$), and 6.276 ($1/2^-$) in ^{17}O, it is shown that two of them are probably states with $T = 3/2$, 5.097 ($3/2^+$) and 5.264 ($3/2^-$). The resonance at 5.609 ($1/2^-$) is probably a mixture of $T = 1/2$ and $3/2$. The experimental apparatus and procedures are described in detail. (JSR)

34806 (ORO-4028-0021, pp 87-92) ISOBARIC CROSS SECTIONS FOR MASSES 6 TO 11 IN REACTIONS OF INTERMEDIATE ENERGY PROTONS WITH CARBON. Roche, C. T.; Clark, R. G.; Mathews, G. J.; Viola, V. E. Jr. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34807 (ORO-4028-0021, pp 113-117) HIGH ENERGY ELASTIC SCATTERING BY RECOIL DETECTION. Poskanzer, A. M.; Zebelman, A. M.; Viola, V. E. Jr. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34808 (ORO-4028-0021, pp 160-162) SPECTRUM OF THE LOW ENERGY FRAGMENTS FROM PROTON-INDUCED SPALLATION OF CARBON. Mathews, G. J.; Clark, R. G.; Roche, C. T.; Meyer, W. G.; Viola, V. E. Jr. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34809 QUASI-BOUND STATES IN (^{3}He,n) AND (^{3}He,p) REACTIONS ON ^{12}C. Gridnev, K. A.; Faiziev, A. R. (Leningrad State Univ.). Yadern. Fiz.; 20: No. 5, 911-914(Nov 1974). (In Russian).

Analysis of angular distributions of neutrons and protons is carried out by means of a distorted-wave method for the quasi-bound states observed in the (^{3}He,n) and (^{3}He,p) reaction experiments on the ^{12}C nucleus. A satisfactory agreement between the calculation and the experiment is obtained; quantum numbers are ascribed to the levels of 6.59 to 9.95 MeV in the ^{13}O nucleus. (auth)

34810 MAGNETIC ELASTIC SCATTERING FROM ^{9}Be AND ^{13}C. Lapikas, L.; Box, G.; de Vries, H. (Instituut voor Kernphysisch Onderzoek, Amsterdam). pp 22-85 of Elastic Electron Scattering from the Magnetization Distribution of ^{9}Be, ^{13}C, and ^{27}Al. Lapikas, L. (ed.). Amsterdam; Instituut voor Kernphysisch Onderzoek (1974).

The scattering of electrons through 180° from ^{9}Be, ^{12}C and ^{13}C targets was observed in the energy range of 35 to 90 MeV. Cross sections for elastic scattering from the magnetization distributions of ^{9}Be and ^{13}C were obtained by subtracting the charge scattering contribution as deduced from the scattering from the spin-zero nucleus ^{12}C. Theoretical predictions for the magnetic cross sections are described in the framework of the shell model, using $(1s)^4(1p)^{A-4}$ configurations and various coupling schemes. Both harmonic oscillator and Woods-Saxon radial wave functions are used to calculate the magnetic form factors, whereas a phenomenological folded-Gaussian density is used to illustrate the model dependence. From a comparison of these experimental results with magnetic cross sections, calculated in distorted wave born approximation magnetic rms radii $\langle r^2\rangle_M^{\frac{1}{2}} = 3.2 \pm 0.3$ fm and $\langle r^2\rangle_M^{\frac{1}{2}} = 3.3 \pm 0.3$ fm are deduced for ^{9}Be and ^{13}C, respectively. For ^{13}C a combined fit to these low-q data and to high q-data, obtained elsewhere from "normal" angle scattering, yields $\langle r^2\rangle_M^{\frac{1}{2}} = 3.4 \pm 0.1$ fm, whereas strong preference is indicated for intermediate coupling (IC) wave functions. The observed scattering from the magnetic dipole moment distribution of ^{9}Be is also close to the IC prediction, as deduced from a fit to the present data and to the 180°-scattering data obtained at Stanford at higher energies. This fit yields $\langle r^2\rangle_M^{\frac{1}{2}} = 3.1 \pm 0.1$ fm, whereas the fitted value of the octupole moment $\Omega = 5 \pm$ _ fm^2 can only be explained by a deformation of the average nuclear potential. The radial size $\langle r^2\rangle_{lp}^{\frac{1}{2}} = 2.85 \pm 0.05$ fm for the lp radial wave function is in agreement with both the ^{9}Be and ^{13}C data. (auth)

34811 MEASUREMENT OF DIFFERENTIAL CROSS-SECTION OF $^{19}F(\gamma,p_0)^{18}O$ REACTION. Tsubota, H.; Abe, K. (Tohoku Univ., Sendai (Japan). Coll. of General Education); Kawamura, N.; Oiawa, S.; Uegaki, J. Kakuriken Kenkyu Hokoku; 6: No. 2, 235-238(Dec 1973). (In Japanese).

Measurement of the differential cross-section of ^{19}F (γ,p_0)^{18}O reaction was performed to obtain information concerning the structure of giant resonance of ^{19}F and ^{20}Ne. The experimental method used is described elsewhere, and is the same as the method used for the measurement of cross-section of ^{31}P and ^{27}Al (γ,p_0) reactions. A 50 micron teflon plate was used as a target and set at 45° to the direction of incident beam. Emitted protons were analysed with a magnetic spectrometer and an obtained proton energy spectrum is shown. Several structures are seen in the spectrum, and strong peaks are observed at 7.3 and 8.5 MeV. A table shows main peaks obtained at various incident electron energy, and assignment whether the peaks correspond to ground state transition. Most of the peaks are due to the ground state transition. The differential cross-section of ^{19}F (γ,p_0)^{18}O reaction at 90° was obtained from the proton energy spectrum by the virtual photon theory, and the obtained cross-section is shown, in which various structures are seen. A characteristic valley is observed at 22 MeV of excitation energy. In comparison with the cross section of ^{19}F (p, γ_0)^{20}Ne, it was found that the (γ, p_0) reaction of ^{19}F and ^{20}Ne occurred owing to similar mechanism. (JA)

34812 ON THE EVALUATION OF NUCLEAR DATA. Igarashi, S.; Nakagawa, T.; Narita, T.; Nishimura, K. (Japan Atomic En-

ergy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). pp 1-9 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese).

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

A review article on the present status of the evaluation of nuclear data is presented. The evaluation begins from the collection of measured values. Since the amount of data is large, a system to handle the measured values is necessary. The evaluation of data is made by picking up required data from the data file. The evaluation of cross sections of ^{240}Pu, ^{239}Pu, ^{238}U, and ^{235}U have been made by the Japan Nuclear Data Committee. The purpose of this evaluation work is to make the consistent evaluation of total cross section and partial cross section. Usually, each measurement of cross section is restricted to some energy range. It is necessary to make the data consistent for the entire energy range required. The selection of data, the statistical analysis of data, and the estimation of the cross section with a theoretical nuclear model or formula are made for the evaluation. The same kind of evaluation is made for the nuclear data on the fission products in fast breeder reactors. The evaluation of data on specific reactions has been made. The examples are the total cross section of carbon and the cross section of the ^{6}Li(n,α) reaction. Evaluated data are filed in a library. The filing of data is a different kind of work from the evaluation. All the data in library should be consistent with each other. (JA)

34813 LOW-ENERGY n-^{16}O ELASTIC SCATTERING PHASE SHIFTS DERIVED FROM THE SUSSEX INTERACTION. Betz, M.; Jeukenne, J. P.; Lejeune, A. (Univ., Liege). Can. J. Phys.; 53: No. 3, 203-206(1 Feb 1975).

The properties of the Sussex interaction are tested in the study of the n-^{16}O elastic scattering described by the potential scattering in the Hartree-Fock field. This force leads to an easy determination of the self-consistent field, but gives $s_{\frac{1}{2}}$ and $d_{\frac{3}{2}}$ phase shifts which are not very satisfactory. This results from the important gap separating bound and unbound states. Further, some uncertainty in the calculation arises from approximations necessary in order to obtain some nondiagonal matrix elements of the two body force which are necessary in the determination of the phase shifts. (auth)

34814 SPECTROSCOPY OF ^{14}O AND ^{16}N NUCLEI WITH THE HELP OF DEUTERON REACTIONS FROM ^{15}N. Grabisch, K. D. Berlin; Freie Univ. (1972). 69p. (In German).

Thesis.

To investigate the reaction mechanisms of the reactions ^{15}N(d,d)^{15}N and ^{15}N(d,p)^{16}N, excitation functions of their differential effective cross sections were absolutely measured at laboratory angles of 30, 60, 120 and 150 degrees in the region of the deuteron entrance energies 4.25-6.25 MeV in steps of 50 keV. The measured excitation functions proceed in the medium, with one exception, within a level 20%. They can be reproduced by an incoherent overlapping of a direct reaction part (DWBA analysis) and of a compound nuclear reaction part (Hauser-Feshbach analysis). On the basis of the measured excitation functions, energy and angular distributions of the reactions ^{15}N(d,d)^{15}N, ^{15}N(d,p)^{16}N and ^{15}N(d,n)^{16}O were absolutely measured at deuteron entrance energies of 5, 5.5 and 6 MeV for the spectroscopy of the nuclei ^{16}O and ^{16}N. The charged ejectiles were spectroscopically observed with semiconductor telescopes, the neutrons with the time-of-flight method. (GE)

34815 HYPERCHARGE EXCHANGE REACTIONS ON NUCLEI. Brueckner, W.; Faessler, M. A.; Kilian, K.; Lynen, U.; Pietrzyk, B.; Povh, B.; Ritter, H. G.; Schruerlein, B.; Schroeder, H.; Walenta, A. H. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F.R. Germany)). Phys. Lett., B; 55: No. 1, 107-110(20 Jan 1975).

In hypercharge exchange reactions (K^-, π^-) on light nuclei Λ particles with small recoil momentum have been produced. The observed hypernuclear states in $^{9}_{\Lambda}$Be, $^{12}_{\Lambda}$C and $^{16}_{\Lambda}$O have simple neutron-hole Λ-particle configurations. (auth)

34816 THE SIGN OF THE MAGNETIC MOMENT OF THE FIRST 2^+ STATE IN ^{18}O. Forterre, M.; Gerber, J.; Vivien, J. P. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de Recherches Nucleaires); Goldberg, M. B.; Speidel, K. H. (Bonn Univ. (F.R. Germany). Inst. fuer Strahlen- und Kernphysik). Phys. Lett., B; 55: No. 1, 56-58(20 Jan 1975).

The measured precession of the ^{18}O(2^+_1) spin in the transient magnetic field experienced on recoil in polarized iron implies a negative g-factor. (auth)

34817 FULL FINITE-RANGE CALCULATION FOR HEAVY ION TWO NUCLEON TRANSFER REACTIONS. Takemasa, T. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)). Phys. Lett., B; 55: No. 1, 28-30(20 Jan 1975).

Finite-range full-recoil DWBA calculations have been performed for the reaction ^{12}C(^{18}O,^{16}O)^{14}C. The form factor is calculated by expanding the two-nucleon overlap as a multipole series of the relative angular momentum of the transferred nucleon pair, which turns out to converge rapidly. In this case the recoil effect does not affect the magnitudes of the cross section and the shape of the angular distribution, except for the forward angles. (auth)

34818 CONTINUUM MODEL AND THE ISO-SPIN SPLITTING OF THE GIANT QUADRUPOLE RESONANCE IN ^{16}O. Rao, C. L.; Ramavataram, K.; Ramavataram, S. (Laval Univ., Quebec City (Canada). Dept. de Physique). Phys. Lett., B; 55: No. 1, 13-16 (20 Jan 1975).

The 1p-1h coupled channels model of photo-nuclear reactions is shown to reproduce the observed splitting of the iso-scalar and iso-vector E2 strengths in ^{16}O. The two relatively intense T = 0 resonances predicted at 14.8 and 19.4 MeV are in good agreement with the 2^+ states observed in the (p,γ) and (α,γ) reactions. The continuum calculation predicts satisfactorily the energy, width and intensity of the giant quadrupole resonance around 27 MeV excitation. (auth)

34819 GAMMA RAY TRANSITIONS FOLLOWING keV NEUTRON CAPTURE IN 2s-1d SHELL NUCLEI. Kenny, M. J. (Australian Atomic Energy Research Establishment, Sutherland); Martin, P. W.; Carlson, L. E.; Biggerstaff, J. A. Aust. J. Phys.; 27: No. 6, 759-771(Dec 1974).

A Ge(Li) detector was used to observe γ-ray transitions after the capture of keV neutrons in natural samples of F, Al, Si, S and Ar. Transitions to positive and negative parity states show that there are strong p-wave resonances as well as s-wave resonances in this mass region. The even-Z nuclei decay more by E1 transitions than by M1. Odd-Z nuclei decay by strong M1 transitions. (auth)

34820 ANALYSIS OF THE ^{16}O(d,d)^{16}O ELASTIC SCATTERING IN THE DEUTERON ENERGY RANGE 1 TO 2.5 MeV. Bondouk, I. I.; Duma, M. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 19: No. 9, 945-947(1974).

The ^{16}O(d,d)^{16}O elastic scattering data of F. Machali et. al. were analyzed in terms of the optical model and a resonance term obtained from the single level approximation theory. (auth)

34821 ENERGY DEPENDENCE OF THE REACTION ^{9}Be(p,p_1)^{9}Be*(1.67). Yasue, M. (Kyoto Univ., Uji (Japan). Inst. for Chemical Research). J. Phys. Soc. Jap.; 36: No. 5, 1254-1260(May 1974).

The ^{9}Be(p,p_1)^{9}Be*(1.67) reaction is studied in the energy range of protons from 4.2 to 5.5 MeV. Fits of the P_1 energy spectra to Watson-Migdal's theory show the value of scattering length between a neutron and ^{8}Be to be about -20 fm, except at E_p = 5.1 MeV, where it is about -30 fm. Analysis with W-M theory shows that the anomaly in the value of the scattering length around E_p = 5.1 MeV is due to the overlapping of final state interactions between a proton, a neutron, and ^{8}Be nucleus. (auth)

34822 HYPERSPHERICAL APPROACH TO THE CLUSTER MODEL. Dzhibuti, R. I.; Krupennikova, N. B.; Tomchinskii, V. Yu. pp 5-21 of Issledovaniya po Teorii Struktury Legkikh Yader. Dzhibuti, R. I. (ed.). Tbilisi, USSR; Izdatel'stvo Metsnierebra (1974). (In Russian).

An analysis is made of the basic equations of the K harmonic method for three-particle cluster configurations. The ground states of ^{6}Li, ^{9}Be, and ^{12}C are used as examples. (JSR)

34823 INVESTIGATION OF THE REACTIONS ^{9}Be(d,p_0)^{10}Be AND ^{9}Be(d,p_1)^{10}Be IN THE ENERGY RANGE 0.9 TO 2.5 MeV. Bondouk, I. I.; Asfour, F.; Machali, F. (Atomic Energy Establishment, Cairo). Rev. Roum. Phys.; 19: No. 10, 1053-1061 (1974).

The reactions ^{9}Be(d,p_0)^{10}Be and ^{9}Be(d,p_1)^{10}Be*(3.37 MeV) were investigated in the deuteron energy range 0.9 to 2.5 MeV. The excitation functions were measured at two laboratory angles 45 and 120° and showed no sharp resonances. The angular distributions (differential cross sections in mb/Sr) were measured in 200 keV intervals. An analysis of the angular distributions of the p_0-group was made using the Butler and the distorted wave theories. (auth)

34824 LOW-LYING ENERGY LEVELS OF ^{10}B. Karadeniz, M. C. (Univ. of Istanbul). J. Phys., A (London); 7: No. 18, 2284-2288(11 Dec 1974).

The nuclear emulsion method has been used to examine neutrons from ^{9}Be(d, n)^{10}B reaction at a deuteron energy of 600 keV on a ^{9}Be target of 4 mm thickness. The well-known energy levels of ^{10}B have been verified, but the data strongly suggest that the 2.9 MeV level, which is the subject of some dispute, is composed of two levels, one at 2.75 MeV and the other at 3.17 MeV. (auth)

34825 EFFECT OF PRESSURE ON ORBITAL ELECTRON CAPTURE. Mukoyama, T.; Shimizu, S. (Kyoto Univ.). Phys. Lett.; 50A: No. 4, 258-260(16 Dec 1974).

The effect of pressure on the decay rate by electron capture has been estimated on the basis of certain simplifying assumptions. For the case of ^{7}Be the order-of-magnitude agreement is found. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 34802, 34819, 35012, and 35022.

34826 (AECL-4931, pp 13-14) RECOIL-DISTANCE LIFE-TIME MEASUREMENTS OF LEVELS IN ^{36}Cl. Alexander, T. K.; Costa, G. J.; Forster, J. S.; McDonald, A. B. Oct 1974.

In Physics Division progress report, July 1 to September 30, 1974.

34827 (BNL-19880) NEUTRON BACKGROUND STUDY FOR LAMPF EXPERIMENT NO. 53: STUDY OF THE NEUTRINO CAPTURE CROSS SECTIONS IN ^{37}Cl WITH μ^+ DECAY NEUTRINOS. Evans, J. C. Jr.; Davis, R. Jr.; Meyer, S. L.; Fowler, E. C.; Cunnane, J. (Brookhaven National Lab., Upton, N. Y. (USA)). Mar 1975. 8p. Dep. NTIS $4.00.

The experimental arrangements for a planned experiment on the neutrino capture cross sections in chlorine-37 are described. Thus far the background is unfavorable, and the final shielding arrangements must yet be decided. (JFP)

34828 (CONF-750303-25) DESCRIPTION OF THE ENDF/B-IV SILICON EVALUATION ENERGY DISTRIBUTIONS OF OUTGOING PARTICLES. Larson, D. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 3p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Calculations are presented for the energy distributions of secondary particles resulting from neutron-induced binary and tertiary reactions on ^{28}Si. (5 figures) (auth)

34829 (ISN-TS-74-3) THEORETICAL ANALYSIS OF EXPERIMENTAL RESULTS ON THE CHARGE-EXCHANGE REACTION ^{38}Ar(^{3}He,t)^{38}K AT 40 MeV. Zeippen, C. J. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires; Grenoble-1 Univ., 38 (France)). 1974. 108p. (In French). INIS.

The analysis is based on a macroscopic and a microscopic model successively. In both cases, the reaction mechanism is supposed to be a one-step process and the transition operator is local. The macroscopic model allows one to determine the influence of optical parameters upon the shape of the cross section angular distributions and to make a choice concerning those parameters. The results of a first study of the five lower levels of ^{38}K are presented. Finally, angular momentum attributions are made for higher levels of ^{38}K. The microscopic model is used to make the results concerning the five lower levels of ^{38}K more accurate. The formalism includes an effective interaction and the values of the parameters of the nucleon–nucleon force are determined by a comparison with experimental data. The values of reference are those which are required to describe a $f_{\frac{7}{2}} \rightarrow f_{\frac{7}{2}}$ transition in the reaction ^{48}Ca(^{3}He,t)^{48}Sc. The influence of the wave functions describing ^{38}Ar and ^{38}K is studied, and deformed components are introduced. It is possible to explain some experimental levels, but others lead to difficulties concerning the amplitude of the cross section, the experimental structure of the angular distribution or the conformity with the selection rules. In conclusion, a possible solution to the remaining questions is suggested. It would consist in a transition operator including a non-local part (non-local force or two-step process). (FR)

34830 LEVELS OF ^{24}Mg OBSERVED IN THE REACTION ^{23}Na(p,α_0)^{20}Ne AT THE PROTON ENERGY E_p = 1.0 TO 2.2 MeV. Khomyakov, G. K.; Strashinskii, A. G.; Matyash, P. P.; Skakun, N. A.; Serykh, N. V. (Physical-Technical Inst., Tashkent). Yadern. Fiz.; 20: No. 5, 846-849(Nov 1974). (In Russian).

Reaction ^{23}Na(p, α_0)^{20}Ne was investigated at the incident proton energy E_p = 1.0 to 2.2 MeV. There were 15 resonance states observed. Angular distributions of the α_0 particles were measured and analyzed in order to determine spin, parity and spin-orbit mixing coefficients. The following spins and parities are obtained for the resonances: 1012 keV–3$^-$, 1093 keV–0$^+$ (1$^-$), 1137 keV–0$^+$ (1$^-$), 1166 keV–(2$^+$), 1575 keV–0$^+$, 1805 keV–1$^-$, 2$^+$, 1979 keV–1$^-$, 2075 keV–2$^+$ (0$^+$, 1$^-$), 2121 keV–2$^+$, 2169 keV–(4$^+$, 5$^-$). The spin-orbit mixing coefficients are presented. (auth)

34831 ISOTOPIC EFFECT IN THE SPALLATION. Batist, L. Kh.; Berlovich, E. E.; Vaishnene, L. A.; Konev, V. G.; Mezilev, K. A.; Novikov, Yu. N. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 20: No. 5, 850-851(Nov 1974). (In Russian).

The production cross sections of nuclei from bombarding the natural Mg and ^{26}Mg by 1-GeV protons are measured. It is shown that the nuclear production cross section depends on the target isospin. (auth)

34832 ELASTIC ELECTRON SCATTERING FROM THE MAGNETIZATION DISTRIBUTION OF ^{27}Al. Lapikas, L.; Dieperink, A. E. L.; Box, G. (Instituut voor Kernphysisch Onderzoek, Amsterdam). pp 4-21 of Elastic Electron Scattering from the Magnetization Distribution of ^{9}Be, ^{13}C, and ^{27}Al. Lapikas, L. (ed.). Amsterdam; Instituut voor Kernphysisch Onderzoek (1974).

Cross sections were measured for the scattering of electrons through 180° from Mg, Al, and Si targets in the energy range from 35 to 95 MeV. Scattering from the magnetization distribution of ^{27}Al is observed as the difference of the scattering from ^{27}Al and from the neighboring doubly even nuclei Mg and Si. Corrections were applied for differences in instrumental effects and in rms charge radii. Theoretical magnetic cross sections were computed with a single-particle wave function and with a shell-model wave function involving configuration mixing. If the distorted-wave Born approximation is used, good agreement with experiment is obtained. In both cases the best fit to the data yields a value of the oscillator range parameter b = 1.71 ± 0.06 fm. Using the q-dependence of the single-particle model a value $\Omega = 18.7 \pm 3.5\ \mu_N \cdot fm^2$ for the magnetic octupole moment of ^{27}Al is found. The present low energy (E < 100 MeV) data are in good agreement with the results obtained from the scattering of high energy (E = 500 MeV) electrons from ^{27}Al through "normal" angles. (auth)

34833 MEASUREMENT AND EVALUATION OF NEUTRON THRESHOLD REACTION CROSS-SECTION AND INVESTIGATION OF FISSION NEUTRON SPECTRA WITH THIS RESULT. Kobayashi, K.; Kimura, I.; Shibata, T. (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.); Goto, H.; Yagi, H. pp 24-33 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese).

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

The purpose of the present study was to obtain the energy dependent cross section of threshold reaction and the average cross section for fission neutrons of ^{235}U. Monochromatic fast neutrons were generated with a 2 MeV Van de Graaff accelerator by using D(dn)^{3}He reaction. The neutron energy at irradiation point was determined by solving the kinematics as was shown by Brolley and Fowler. The neutron flux was measured by proton recoil counter method with two recoil proton radiators and two Si detectors. Induced activity of the threshold detector was measured with a NaI(Tl) scintillation counter or a Ge(Li) detector. The response function of the recoil detector was calculated, and compared with measured values. The cross section of the ^{115}In(n,n')^{115m}In reaction was measured. Observed values were close to those by Martin et al., and Menlove et al. at around 3.4 MeV. The values above 3.4 MeV were close to the values by Butler and Santry. Systematic error of the present measurement seemed to be small. The average cross section of threshold reaction for prompt fission neutrons of ^{235}U was measured with the heavy water thermal neutron facility at Research Reactor Institute of Kyoto University (KUR). A small enriched uranium-aluminum foil was used for a fission neutron source. The number of fission neutrons was obtained from the measurement of the gamma ray from ^{140}La–^{140}Ba in the foil and the average number of prompt neutrons. The average cross section of ^{58}Ni(n,p)^{58}Co, ^{27}Al(n,α)^{24}Na and ^{115}In(n,n')^{115m}In reactions was obtained. Hereafter this method will be used for the measurement of the cross section of threshold reactions. The fission neutron spectrum of ^{235}U was investigated by using the obtained energy dependent cross section of threshold reaction and the average cross section. (JA)

34834 ELASTIC AND INELASTIC SCATTERING OF IDENTICAL HEAVY IONS. Emling, H.; Nowotny, R.; Pelte, D.; Schrieder, G.; Weidenmeier, W. (Heidelberg Univ. (F.R. Germany). 1. Physikalisches Inst.). Nucl. Phys., A; 239: No. 1, 172-188 (17 Feb 1975).

The elastic and scattering of ^{12}C + ^{12}C, ^{24}Mg + ^{24}Mg, ^{28}Si + ^{28}Si was studied at bombarding energies $E_{c.m.}$ = 5–18.8, 20–33, 29–36 MeV, respectively. The experimental arrangement includes two position-sensitive detectors covering the angular ranges from θ_{lab} = 20°–70°. The results are compared to calculations within the framework of the diffraction and optical model. A phase-shift analysis is performed for the elastic scattering data of the ^{12}C + ^{12}C system. It is shown that a shallow nuclear potential is needed to reproduce the ^{28}Si + ^{28}Si results and that the ^{12}C + ^{12}C scattering shows evidence of resonance formation in the elastic channel. (auth)

34835 STUDY OF THE ^{28}Si(d,p)^{29}Si REACTION AT 3.22 MeV. Burjan, V.; Cejpek, J.; Kroha, V.; Kremenek, J. (Inst. of Nuclear Physics, Rez, Czech.). Czech. J. Phys.; B24: No. 12, 1314-1321 (1974).

The differential cross section of the ^{28}Si(d,p)^{29}Si reaction at a deuteron energy of 3.22 MeV was measured and analyzed including transitions to final states in ^{29}Si up to the 5.809 MeV level. Angular distributions are compared with the DWBA and Hauser–Feshbach calculations. Satisfactory agreement is obtained for most of the levels. An attempt is made to explain the angular distribution leading to the excitation of the 4.078 MeV level as a two-step process. (auth)

34836 DECAY OF THE ^{16}O–^{16}O SYSTEM INTO COMPOUND STATES. Deubler, H. H.; Fliessbach, T. (Technische Univ. Muenchen, Garching (F.R. Germany). Teilinstitut Theorie im Physik-Dept.). Nucl. Phys., A; 238: No. 3, 409-421(10 Feb 1975).

In a simple oscillator model the transition matrix elements between the ^{16}O–^{16}O system and ^{32}S compound states are estimated. The configuration space for the sulfur states includes the 3 $\hbar\omega$ shell. The density of these states is estimated in the statistical model. The main result is that only one special configuration is strongly coupled to ^{16}O–^{16}O. Possible consequences of this preference are discussed. (auth)

34837 RE-INTERPRETATION OF ^{28}Si(p,p)^{28}Si CROSS-SECTION AND POLARIZATION MEASUREMENTS IN THE GIANT DIPOLE RESONANCE REGION. Weller, H. R. (Florida Univ., Gainesville (USA). Dept. of Physics and Astronomy); Divadeenam, M. (Duke Univ., Durham, N. C. (USA)). Phys. Lett., B; 55: No. 1, 41-44(20 Jan 1975).

The ^{28}Si(p,p)^{28}Si cross section and polarization data previously published are re-examined. It is shown that a strong $^5/_2^+$ resonance can account for the data. A calculation predicts the existence of a $^5/_2^+$ 2p–1h doorway state in the ^{29}P giant dipole resonance region. (auth)

34838 ROLE OF THE CROSS-SECTION NORMALIZATION IN THE CONCLUSIONS DRAWN FROM THE COUPLED-CHANNEL COLLECTIVE MODEL ANALYSIS OF THE INELASTIC SCATTERING EXPERIMENTS. Kiss, A. (Roland Eotvos Univ., Budapest). Acta Phys. Acad. Sci. Hung.; 37: No. 3, 275-279(1974).

Conclusions drawn from the inelastic scattering experiments were examined in order to learn about their sensitivity to the slight errors of the absolute normalization of the analyzed cross sections while keeping the elastic-inelastic relative normalization constant. The analysis has shown that the conclusions on the collective properties of the target nucleus gained by the method of the coupled-channel do not critically depend on the accurate determination of the absolute cross section. (auth)

34839 THE (^{3}He,d), (d,p), AND (d,n) REACTIONS ON ^{28}Si. Leleux, P.; Macq, P. C.; Meulders, J. P.; Pirart, C. (Louvain Univ. (Belgium). Inst. de Physique Corpusculaire). Z. Phys.; 271: No. 2, 139-148(Dec 1974).

The ^{28}Si(^{3}He,d)^{29}P reaction and the ^{28}Si(^{3}He,^{3}He)^{28}Si elastic scattering are performed at a bombarding energy of 35.3 MeV; angular distributions are obtained for 13 deuteron groups, up to an excitation energy of 7.5 MeV in ^{29}P. From a DWBA analysis, spectroscopic factors are derived for bound and unbound levels; they favorably compare with shell-model predictions, but they strongly depend on the incident ^{3}He energy and on the bound-state well parameters. The ^{28}Si(d,n)^{29}P and ^{28}Si(d,p)^{29}Si reactions, and the ^{28}Si(d,d)^{28}Si elastic scattering are studied at an incident energy of 13.5 MeV. The angular distributions are DWBA analyzed. From a comparison of spectroscopic factors for analog states in ^{29}Si and ^{29}P, the extrapolation method is shown to be valid for quasi-bound states in ^{29}P. (auth)

34840 RATE-DEPENDENT EFFECTIVE POTENTIAL OF S-WAVE INTERACTIONS AND THE CLUSTER STRUCTURE OF ^{20}Ne. Sallam, Kh. M. pp 85-89 of Issledovaniya po Teorii Struktury Legkikh Yader. Dzhibuti, R. I. (ed.). Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

The cluster structure of ^{20}Ne was examined on the basis of the use of a rate-dependent effective potential of the S-wave interaction. Numerical calculations of the binding energy and the nuclear dimension were obtained and compared with values obtained previously. (JSR)

34841 CONFIGURATION OF THE 10.22 MeV ANALOGUE LEVEL IN ^{37}Cl. Keinonen, J.; Bister, M.; Anttila, A. (Univ. of Helsinki). J. Phys. G, Nucl. Phys.; 1: No. 1, 53-56(10 Jan 1975).

The ^{36}S(p, p)^{36}S reaction has been investigated in the analogue resonance region at E_p = 1.89 MeV. Spin, parity and isospin, $J^\pi = ^1/_2^-$, $T = ^3/_2$, have been confirmed for the 10.22 MeV state in ^{37}Cl. Total, proton and γ widths have been determined as $\Gamma = 35 \pm 8$ eV, $\Gamma_p = 23 \pm 5$ eV, $\Gamma_\gamma = 12 \pm 5$ eV. The reduced proton width is assigned a value of 0.019 in units of the Wigner limit. (UK)

34842 MULTISTEP PROCESSES IN THE (d,t) AND (d,^{3}He) REACTIONS ON ^{30}Si AND THE STRUCTURE OF MASS 29 NUCLEI. Hilko, R. A. Durham, NC; Duke Univ. (1974). 164p. University Microfilms Order No. 75-2385.

Thesis (Ph. D.).

Sixteen states with excitation energies < 6.2 MeV and the 8.34-MeV $^5/_2^+$, $t_{19} = ^3/_2$ state were studied in ^{29}Si. The first eight levels in ^{29}Al with excitation energies < 3.5 MeV were studied. The coupled-channel Born approximation (CCBA) was used to test two nuclear models, the rotational model with bandmixing and the shell model. The study of the inelastic effects in the scattering from the target nucleus was done for each level, but due to current limitations the study of the inelastic effects in the residual nucleus could only be done properly for the ground-state rotational band of ^{29}Si. The need for multistep processes was found in the majority of levels. With the use of the rotational model with bandmixing, electromagnetic transition rates, lifetimes, and branching ratios were determined. This calculation supported the CCBA results in favoring this model over the shell model. A complete calculation in a deformed Woods–Saxon potential was performed to determine energy levels and wave functions for various orbits. The results are very similar to the work of Nilsson, who used a harmonic oscillator basis. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 34791, 34833, 34864, 34866, 34987, and 35022.

34843 (AECL-4931, pp 18-20) FERMI BETA DECAY, A > 40: THE HALF-LIVES OF ^{46}V, ^{50}Mn, AND ^{54}Co. Hardy, J. C.; Andrews, H. R.; Geiger, J. S.; Graham, R. L.; Macdonald, J. A.; Schmeing, H. Oct 1974.

In Physics Division progress report, July 1 to September 30, 1974.

34844 (LUNP-7410) PROTON HOLE STATES EXCITED BY MONOENERGETIC GAMMA QUANTA. Wene, C. O. (Tekniska Hoegskolan, Lund (Sweden). Institutionen foer Kaernfysik). 1974. 43p. Dep. NTIS (US Sales Only) $2.25.

Earlier work has shown how information about the giant dipole resonance and proton-hole states can be inferred from high resolution photoproton spectra obtained in irradiation with the 17.62 MeV gamma quanta produced by the ^{7}Li(p,γ)^{8}Be-reaction. To exploit this method the high energy photoproton spectra from ^{45}Sc, ^{51}V, ^{59}Co, ^{58}Ni, ^{63}Cu and natural nickel have been measured with 60–120 keV resolution. The absolute cross sections for transitions to levels in the daughter nucleus have been determined. The results are compared with a simple model assuming a semidirect reaction proceeding via a dipole doorway state. Good correlation is found between the cross sections and the spectroscopic factors measured in proton pick-up reactions. Comparison with the total photoproton cross section for ^{58}Ni indicates, however, that the majority of protons are emitted at lower energies from more complicated states. (auth)

34845 EVALUATION ERROR OF THE FAST NEUTRON CROSS-SECTION OF IRON. Yamakoshi, H. (Ship Research Inst., Tokyo (Japan)). pp 18-23 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese).

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

The effect due to the fluctuation of evaluated values on the result of practical calculation was investigated. The fluctuation dependence of the neutron spectra in an iron sphere was studied. The evaluated data files used for the study were UNC, KFK-750 and ENDF/B. The calculation of neutron transport was carried out according to the one dimensional spherical computer code PALLAS-1D which is based on the discrete-ordinate-direct integral method. The UNC data were used as standard. The measured data on elastic scattering cross sections of iron around 10 MeV have been few, and the evaluated data in this range have been estimated theoretically. The values of differential scattering cross section based on this estimation can be composed by the use of Legendre coefficient. Comparison of the Legendre coefficient from UNC data and ENDF/B-III was made. The numerical values of both data were different. The differential cross section from ENDF/B-III was larger than that from

UNC data, and were not in good agreement. When the data files give higher order than 5 of the Legendre coefficient, error is limited within 5%. Comparison of the inelastic scattering cross section of iron in ENDF/B-III, UNC and KFK-750 data files was carried out. Inconsistency was seen when the energy level was higher than 0.845 MeV. The total cross section from UNC data gave proper mean values. Comparison of the measured and calculated energy spectra of neutrons in iron assembly was performed. Deviation of calculated flux due to the change of nuclear data is shown. The accuracy of cross section curves and the accuracy of estimation of the Legendre coefficient in elastic scattering have large effects on the calculation of neutron transport. (JA)

34846 INVESTIGATION OF THE REACTION $^{55}Mn(n,\gamma)^{56}Mn$. Colenbrander, A. H.; Kennett, T. J. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 53: No. 3, 236-250(1 Feb 1975).

A pair spectrometer was used to make a detailed study of the $^{55}Mn(n,\gamma)^{56}Mn$ reaction. A total of 268 transitions were observed, and most of the intense components were included within a proposed decay scheme. The agreement between level energies deduced from (d,p) measurements and the present (n,γ) data is excellent. A recently reported technique for analyzing complex spectra was used to obtain an estimate of the nuclear temperature and to permit the establishment of an absolute intensity scale. (auth)

34847 EFFECT OF ELASTIC SCATTERING REMOVAL CROSS SECTION ON NEUTRON SPECTRA. Yamamuro, N.; Kami, H. (Tokyo Inst. of Tech. (Japan). Research Lab. of Nuclear Reactor). pp 87-91 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese).

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

The approximation formula of the elastic scattering removal cross section utilized in ABBN set probably errs in cases where a small number of broad resonance scattering exist in a group. Hereupon the correct evaluation of the removal cross section was tried at the time of the analysis of pulsed neutron experiment on an iron system. Two calculated values were compared with each other on the neutron spectrum in the iron system in which neutrons are moderated by elastic scattering. The one was calculated by using the cross section of ABBN Set, and the other by using the cross section which had been calculated by assuming that collision density was constant. The former showed a higher peak and a lower dip at resonance position than the latter. In case of the latter, the neutron spectrum calculated by using the new calculation method has almost the same values as the experimental values at resonance point. As a result, when fast neutron reactors are treated as homogeneous, the neutron spectrum calculated by employing existing removal cross section may differ little from the experimental one. But when coolant or structural materials are treated as heterogeneous, the removal cross section must be calculated correctly by a more efficient method. (JA)

34848 (p,d) REACTIONS AT 52 MeV. I. $^{58}Ni(p,d)^{57}Ni$ (Experimental). Ohnuma, H.; Suehiro, T.; Sekiguchi, M.; Yamada, S. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). J. Phys. Soc. Jap.; 36: No. 5, 1236-1244(May 1974).

The $^{58}Ni(p,d)^{57}Ni$ reaction was studied at E_p = 51.93 MeV with a magnetic spectrometer. Experimental results and spectroscopic information obtained are presented. (auth)

34849 (p,d) REACTIONS AT 52 MeV. II. $^{58}Ni(p,d)^{57}Ni$ (Analysis). Ohnuma, H.; Suehiro, T.; Sekiguchi, M.; Yamada, S. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). J. Phys. Soc. Jap.; 36: No. 5, 1245-1253(May 1974).

Angular distributions for the $^{58}Ni(p,d)^{57}Ni$ reaction at E_p = 51.93 MeV are analyzed using the distorted wave Born approximation theory and the adiabatic theory for the deuteron breakup. Parameter dependence of the calculated results is investigated in detail. Modification of low partial wave contributions is required to obtain reasonable fit with DWBA. Well-radius description in the form factor calculation is found to show general superiority to conventional well-depth description. (auth)

34850 STUDY OF T > STATE BY (e,e'p) AND (e,e'α) REACTIONS. Otkawa, S.; Suzuki, A.; Uegaki, J.; Tamae, T.; Saito, T. (Tohoku Univ., Sendai (Japan). Lab. of Nuclear Science). Kakuriken Kenkyu Hokoku; 6: No. 2, 239-245(Dec 1973). (In Japanese).

The measurement of cross-sections of (e,e'p) and (e,e'α) reactions was made, and the spectra of emitted protons were observed. The observed cross-sections of (γp) reaction for ^{45}Sc and ^{46}Ti are shown in figures. The cross-sections were derived from the data of emitted protons above 2.5 MeV. Cross-sections of (γ, n + np + 2n + ...) reaction are also shown in the figures for comparison. Experimental values of $d\sigma(\gamma,p_0)/d\Omega_{90°}$ are shown in the figures. A peak around 16 MeV for ^{46}Ti seems to be T < GDR. The strength ratio of T < GDR and the energy splitting [ΔE] between T < GDR and T > GDR were obtained. The strength ratio was larger than theoretical values, and the energy splitting was smaller than theoretical values. Yield curves of the (e,e'p) reaction of ^{175}Lu and ^{197}Au were obtained to study isobaric analog state (IAS). It was found that the position of the ground-IAS of ^{175}Yb was lower than a theoretical value by 460 keV and the position of $^{1}/_{2}^{-}$ [503] state was lower by 490 keV. This result shows similar tendency to the values for ^{169}Tm and ^{181}Ta. The results of $^{197}Au(e,e'p)$ reaction showed that the excitation energy of IAS in spherical nuclei was in agreement with theoretical ones. (JA)

34851 STUDY OF THE REACTION $^{57}Fe(p,n)^{57}Co$ FOR EXAMINING THE HAUSER/FESHBACH AND ULLAH FORMULA. Pietrzyk, P. Berlin; Freie Univ. (1971). 67p. (In German). Thesis.

In a neutron time-of-flight measurement of the reaction $^{57}Fe(p,n)^{57}Co$, differential and integral cross sections for beam energies of 4.9 and 5.6 MeV and transitions into different final states were determined. Besides, excitation functions for this reaction and gamma spectra of the reaction $^{57}Fe(p,n\gamma)^{57}Co$ were measured. Thus the level scheme of ^{57}Co was completed. The main point was the examination of two formulas of the statistical model with the help of experimental data. The Ullah formula does not reproduce the measured values. The Hauser/Feshbach formula reproduces the experimental results quite well, in spite of the large transmission coefficients. (GE)

34852 POSSIBLE NUCLEAR STRUCTURE EFFECTS SEEN IN $^{6}Li,d)$ f-p SHELL REACTIONS. DeVries, R. M.; Fulbright, H. W.; Markham, R. G.; Strohbusch, U. (Rochester Univ., N. Y. (USA). Nuclear Structure Research Lab.). Phys. Lett., B; 55: No. 1, 33-36(20 Jan 1975).

A finite-range DWBA analysis has been made of ground-state angular distributions from $^{6}Li,d)$ experiments on twelve fp shell nuclei at 28 or 32 MeV. Good fits were obtained. A systematic variation in bound-state radius was required. The interpretation of this effect using microscopic wavefunctions suggests that four-nucleon structure information may be obtained from the shapes of the angular distributions. (auth)

34853 DEEP INELASTIC FRAGMENT PRODUCTION IN THE ^{40}Ca ON ^{40}Ca INTERACTION AT 278 MeV. Colombani, P.; Frascaria, N.; Jacmart, J. C.; Riou, M.; Stephan, C.; Doubre, H.; Poffe, N.; Roynette, J. C. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). Phys. Lett., B; 55: No. 1, 45-48 (20 Jan 1975).

Deep inelastic fragment production in the symmetrical reaction ^{40}Ca on ^{40}Ca has been studied at E_{lab} = 278 MeV, high above the Coulomb barrier. Kinetic energy distributions and angular distributions have been obtained for products in the Z = 8-22 region. The two-body nature of the mechanism is discussed. Sequential decay of primary fragments is shown to be important. (auth)

34854 SPIN DETERMINATION FROM ANGULAR STRUCTURE OF $p_{\frac{1}{2}}$ PROTON TRANSFER IN THE $^{45}Ca(^{15}N,^{14}C)^{46}Sc$ REACTION. Henning, W.; Kovar, D. G.; Erskine, J. R.; Greenwood, L. R. (Argonne National Lab., Ill. (USA)). Phys. Lett., B; 55: No. 1, 49-52(20 Jan 1975).

The angular momentum selection rules for the transfer of p nucleon to $j_>$ and $j_<$ final states and the recently observed angular L-dependence in heavy-ion transfer reactions can be used to determine final-state spins. This is shown for the reaction $^{45}Ca(^{15}N,^{14}C)^{46}Sc$. (auth)

34855 QUASI-ELASTIC ELECTRON SCATTERING. II. Transverse Components for ^{40}Ca and Discussions. Kawazoe, Y. (Tohoku Univ., Sendai (Japan). Dept. of Physics). Kakuriken Kenkyu Hokoku; 7: No. 1, 23-42(Jun 1974).

Transverse components of 1p-1h excitation to continuum states in a square well shell model are found not to be so small compared to longitudinal excitations at $q \gtrsim 1fm^{-1}$ in ^{40}Ca. The maximum and minimum quasi-elastic background are defined and discussed. (auth)

34856 STUDY OF ATOMIC NUCLEI BY ELECTRON SCATTERING. Torizuka, Y.; Kojima, Y. (Tohoku Univ., Sendai (Japan). Lab. of Nuclear Science); Saito, T.; Ito, K.; Nakata, A. Kakuriken Kenkyu Hokoku; 6: No. 2, 165-210(Dec 1973). (In Japanese).

The giant resonance was measured by the electron scattering of ^{40}Ca, ^{58}Ni, ^{116}Sn, and ^{197}Au and analyzed. By using various detectors to average characteristic dispersion, the reliability of data was improved. The proportion of occupying energy weighted sum rule (EWSR) was obtained when the peak at $65A^{-1/3}$ MeV or

130 $A^{-\frac{1}{3}}$ MeV of excitation energy was assumed as E2 transition. It was found that heavier nuclei have larger proportion. The experiment for ^{40}Ca showed that E2 excitation and E3 resonance have about 70 and 40% of the proportion, respectively. The E1 giant resonance of ^{58}Ni at 18.5 MeV occupies 100% of EWSR. The form factor for the other resonance of ^{58}Ni was also obtained. The electron scattering experiment of ^{116}Su showed E2 resonance level at 12 MeV and a broad E2-like peak at 25 MeV as well as the E1 giant resonance at 15.7 MeV. A form factor was obtained for these levels. The E1 giant resonance of ^{197}Au was seen at 13.7 MeV, and other broad resonances were observed at 11 and 23 MeV. The form factor was obtained to investigate the characteristics of a resonance. Finally, a comment concerning the correction for bremsstrahlung is presented. Formulas used for the correction are described. (auth)

34857 THE DECAY OF ^{46}K. Ichimura, T.; Takeda, Y.; Shinozuka, T.; Kotajima, K. (Tohoku Univ., Sendai (Japan). Faculty of Engineering). Kakuriken Kenkyu Hokoku; 7: No. 1, 184-189(Jun 1974). (In Japanese).

Gamma rays of 1.347, 1.675, 2.030, 2.266, 3.019, 3.060, 3.708, 4.030, 4.186, and 5.059 MeV were observed following the decay of ^{46}K which was produced by the ^{48}Ca(γ,pn)^{46}K reaction with 60-MeV bremsstrahlung. The decay curve was measured with a plastic scintillation counter and analyzed by using multiple component direct fitting method giving a result of $T_{\frac{1}{2}}$ = 108.3 ± 3.3 sec. (auth)

34858 PROTON STRIPPING TO LEVELS OF ^{53}Mn. Gunn, G. D. Tallahassee; Florida State Univ. (1974). 170p. University Microfilms Order No. 75-8046.

Thesis (Ph. D.).

The Florida State University quadrupole spectrometer was used to study the levels of ^{53}Mn with the reactions ^{52}Cr(^{3}He,d)-^{53}Mn at 24 MeV and ^{52}Cr(^{7}Li,^{6}He)^{53}Mn at 34 MeV. Angular distributions were taken from 5 to 60° for ^{52}Cr(^{3}He,d)^{53}Mn, and from 1 to 25° for the ^{52}Cr(^{7}Li,^{6}He)^{53}Mn reaction. Angular distributions show the expected L-dependent shapes which are well described by the DWBA. Relative spectroscopic factors are in excellent agreement with previous studies. The J-dependent shape of the (^{7}Li,^{6}He) angular distributions at forward angles is used to identify the 2.68 and 3.48 MeV levels as $p_{\frac{3}{2}}$, and the 4.07 and 4.43 MeV levels as $p_{\frac{1}{2}}$. Absolute spectroscopic factors for the two reactions are in very good agreement and are about 30% lower than the values of the previous studies. Seventeen levels of ^{53}Mn above 6 MeV are observed in one or both reactions. Angular distributions for eight levels are extracted for the (^{3}He,d) reaction, including the three isobaric analog levels at 6.97, 7.55, and 8.03 MeV. Several of the levels above 6 MeV exhibit angular distributions which might be interpreted as being for either l = 3 or l = 4 transferred. These levels are identified as g-wave final states on the basis of their strength and excitation energy. The spectroscopic factors for the unbound levels are derived by an extrapolation technique from the bound state analysis. The spectroscopic factors extracted for the isobaric analog levels are consistent with (d,p) results to the parent states, within the limitations of the analysis. The characteristics of the quadrupole spectrometer, and its use in taking spectroscopic data, are discussed. (Diss. Abstr. Int., B)

34859 INTERMEDIATE COUPLING MODEL DESCRIPTION OF ^{55}Fe AND ^{57}Fe. Dikshit, J. J.; Singh, B. P. (Physical Research Lab., Ahmedabad, India). Pramana; 3: No. 5, 323-337 (Nov 1974).

The properties of the negative parity states of ^{55}Fe and ^{57}Fe are investigated in the framework of the intermediate coupling model. In the model, a neutron or a quasineutron is coupled to anharmonic vibrations of the core. Anharmonicities of the vibrations are estimated through the observed properties of the core. Energy levels, spectroscopic factors and electromagnetic properties were calculated. The results of the present calculations are also compared with available experimental results and other theoretical results. The model reasonably accounts for many of the properties of the low lying states. (auth)

34860 EFFECTS OF ELECTRON AND PROTON DISTORTIONS IN THE (e,e'p) REACTIONS. Gorchakov, V. V.; Lukyanov, V. K.; Pol, Yu. S.; Reznik, B. L. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol.; B6: No. 1, 93-103 (1975).

The quasielastic (e,e'p) cross section has been derived taking into account the Coulomb distortion of electrons in the framework of the high energy approximation. In comparison with the plane wave approach, in the usual kinematics, the $d^4\sigma$ cross section of the ^{40}Ca (e,e'p) reaction increases in magnitude by 10-20% due to the electron distortion and decreases 3-4 times due to the inclusion of the proton optical potential. Then if one takes into account the diffuseness of nuclei in the hole-state dynamic-potential model, the $d^4\sigma$ cross section relatively increases 2-3 times in the energy range of 1p- and 1s-peaks. (auth)

34861 THE g FACTOR OF THE 235 keV STATE IN ^{44}Sc. Dracoulis, G. D.; Foote, G. S.; Slocombe, M. G. (Australian National Univ., Canberra). J. Phys., A. (London); 7: No. 18, 2289-2294(11 Dec 1974).

The g factor of the 235 keV, 2^- state in ^{44}Sc has been measured by observing the time-integrated perturbation of the de-exciting γ ray angular distributions under the influence of an externally applied magnetic field. The result, g = +0.29 ± 0.07, supports the assignment of this state as a member of the K = 0 rotational band. (auth)

34862 UNAMBIGUOUS HELION OPTICAL POTENTIAL AT 83 MeV. Weisrose, S. A. (King's Coll., London). J. Phys. G, Nucl. Phys.; 1: No. 1, L1-L5(10 Jan 1975).

The elastic scattering ^{56}Fe(^{3}He, ^{3}He)^{56}Fe at an incident energy of 82.7 MeV has been measured. Only one potential family, with a volume integral of 333 MeV fm^3, fitted the data. (auth)

34863 LIFETIME MEASUREMENTS IN ^{42}Ca. Wuest, N. (Univ., Cologne); Uhrmacher, M.; Daul, J.; Lieb, K. P.; Kleinfeld, A. M. J. Phys. G, Nucl. Phys.; 1: No. 1, 57-66(10 Jan 1975).

High spin states in ^{42}Ca between 4.1 and 7.4 MeV excitation energy were populated in the reaction ^{28}Si(^{16}O, 2p) at 36.5 to 50 MeV beam energy. By using the recoil distance Doppler shift method, their lifetimes and upper limits of their spins were determined. Neither strongly enhanced E2 transitions nor rotational-like behavior of these states were observed. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 34131, 34844, 34888, 34905, 34942, 34954, and 35049.

34864 (CONF-750303-23) ORNL NEUTRON SCATTERING CROSS SECTION MEASUREMENTS FROM 4 TO 8.5 MeV. Kinney, W. E.; Perey, F. G. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 9p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The ORNL program to measure neutron elastic and inelastic scattering cross sections for 26 nuclides from C to ^{238}U in the energy range 4 to 8.5 MeV is summarized. Data acquisition and reduction techniques are reviewed, and typical results are given. The nuclides investigated are tabulated. (4 figures, 1 table) (auth)

34865 (JINR-P6-8279) DECAY OF ^{77}Rb. Liptak, Ya.; Habenicht, W. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The decay scheme ^{77}Rb-^{77}Kr has been built based on the observed γ-transitions, γ-γ coincidences and on the measured boundary energy of β-transition to the 66.5 keV state. The values lg ft of β-transitions and the quantum characteristics of some low-lying levels of ^{77}Kr have been determined. (auth)

34866 (LYCEN-74-33) STUDY OF DIFFERENT EMISSION CHANNELS IN THE CONTINUUM FOR NUCLEAR REACTIONS INDUCED BY ^{3}He AT MEDIUM ENERGY. Chevarier, A. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire; Lyon-1 Univ., 69 (France)). 1974. 114p. (In French). INIS.

The purpose is to study the preequilibrium emission in nuclear reactions induced by ^{3}He with a 25.6 MeV incident energy. The energy spectra of the three most important particles emitted (n,p,α) have been obtained from reactions on ^{57}Fe, ^{61}Ni, ^{62}Ni, ^{63}Cu target nuclei. The analysis has been extended to (^{3}He,p) reactions on ^{59}Co, ^{64}Ni, ^{115}In, ^{116}Sn, ^{117}Sn target nuclei and (d,p) reactions on ^{57}Fe, ^{59}Co, ^{60}Ni, ^{61}Ni, ^{63}Cu, ^{116}Sn, ^{197}Au in order to explain a particular contribution appearing in proton spectra. The shape analysis of proton and neutron spectra shows that the emission is characterized by a four-exciton initial state. This value is explained by a quick dissolution of the incident ^{3}He particle followed by the excitation of a nucleon of the target nucleus. In the case of α particle emission, the slope method suggests a two-exciton initial configuration similar to a pick-up mechanism. By means of a sequential calculation (from the initial configuration to the statistical equilibrium), the hybrid model allows reproducing the shape and amplitude of energy spectra for the three most important particles emitted. According to earlier results concerning alpha preequilibrium emission, a value of 0.12-0.15 for the probability that four correlated nucleons exist was required in order to

fit the spectra. The influence of the diffuse edge of the nucleus and the isospin conservation is taken into account. A simple phase-space calculation justifies the shape of the proton spectra emitted in (d,p) reactions in the mass region ranging from iron to gold. These calculations allow assignment to a double stripping mechanism of the particular component observed in (^{3}He,p) reactions. This observation is confirmed by excitation functions and coincidence measurements. (FR)

34867 THEORY OF EXCITED STATES OF ODD–ODD ATOMIC NUCLEI. Israilov, A. A.; Sharipov, Sh. (Inst. of Nuclear Physics, Tashkent). Yadern. Fiz.; 20: No. 5, 862-867(Nov 1974). (In Russian).

Energies of rotational one-particle states of odd–odd nonaxial atomic nuclei deformed in the ground state are calculated. It is shown that the level symmetry related to $\gamma = 30°$ is absent, the levels at $\gamma \to 0°$ and $\gamma \to 60°$ are quite different. The results of the theoretical calculations are compared with the experimental data for the nuclei ^{62}Cu, ^{64}Cu, ^{66}Cu, ^{142}Pm, ^{144}Eu, ^{174}Lu. (auth)

34868 ^{58}Ni, ^{60}Ni, ^{62}Ni(γ,α_0) REACTIONS. Sugawara, M. (Tohoku Univ., Sendai (Japan). Lab. of Nuclear Science); Kawamura, N.; Tsubota, H.; Miyase, H.; Abe, K. Kakuriken Kenkyu Hokoku; 6: No. 2, 246-255(Dec 1973). (In Japanese).

The cross section of (γ,α_0) reaction was measured and analyzed on Ni isotopes. Electron beam from an electron linear accelerator bombarded targets directly, and emitted alpha beam was measured with a broad band magnetic analyzer. The targets used were 9.6mg/cm^2 thick ^{58}Ni, 5.68mg/cm^2 thick ^{60}Ni and 7.84mg/cm^2 thick nickel foil (96.16% ^{62}Ni, 1.63% ^{58}Ni, 1.42% ^{60}Ni). The differential cross section of (γ, α_0) reaction was obtained from the energy spectra of emitted particles. The obtained cross sections are shown in figures in relation to gamma-ray energy. The results were compared with the results of inverse reaction ^{56}Fe(α, γ_0). The values derived from the ^{56}Fe(α, γ_0) reaction were different from the present results by a factor of 2, and the reason of difference was not known. The cross section was also calculated by using compound nucleus model. The process considered for the calculation was that the target nucleus was excited to E1 giant resonance state by the absorption of γ ray, and transformed to the ground state of a remaining nucleus through a compound nucleus. The calculated position of maximum cross section and the relative values of cross section for the respective targets were in good agreement with the experimental values. (JA)

34869 DECAY OF ^{81}Se ISOMERS. Venkataratnam, S.; Narasimham, K. L.; Lakshminarayana, V. (Andhra Univ., Visakhapatnam, India). Indian J. Phys.; 48: No. 8, 735-740 (Aug 1974).

The gamma rays following the beta decay of ^{81}Se isomers were investigated with a 2-cm^3 Ge(Li) detector. Fifteen gamma transitions were observed, confirming several already known gamma rays and yielding four new gamma rays at energies 201, 375, 815, and 1352 keV. All the gamma rays are fitted in a level scheme requiring two new levels at 815 keV and 1352 keV. Relative intensities of the gamma rays and log-ft values of the various beta branchings, populating levels in ^{81}Br, are calculated and discussed in relation to their spin and parity assignments. (auth)

34870 ELECTRIC QUADRUPOLE INTERACTION OF RECOIL-IMPLANTED ZINC IN CADMIUM. Bartsch, W.; Golczewski, J.; Leitz, W.; Mahnke, H. E.; Semmler, W.; Sielemann, R.; Wichert, T. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F.R. Germany). Bereich Kern- und Strahlenphysik). Phys. Lett., A; 50: No. 6, 413-414(13 Jan 1975).

The electric quadrupole interaction of the 605 keV $^3/_2^+$ state of ^{67}Zn in Cd metal was measured by the recoil implantation technique combined with the DPAD method (DIMPAD). The result, $\nu Q = eQV_{ZZ}/h = 39.0(4)$ MHz (T = 373 K), is compared with the known quadrupole coupling constants in the Zn–Cd system. (auth)

34871 NUCLEAR INTERACTIONS OF NON-RELATIVISTIC MULTICHARGED COSMIC RAY PARTICLES. Levkovskii, A. A.; Ostroumov, V. I. (Leningrad Polytechnic Inst.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1820-1823(Sep 1974). (In Russian).

An emulsion chamber was exposed at an altitude of 35 km. There were 86 cases of the spallation of the photoemulsion nuclei by cosmic ray particles (Z > 3) in the energy interval from 100 to 500 MeV/nucleon were recorded. Data were obtained on the mean free path distribution of the low-energy secondary particles and the angular distribution of fast secondary particles. (tr-auth)

34872 PREPARATION OF ^{73}Ga MOESSBAUER SOURCE IN GERMANIUM THROUGH PHOTONUCLEAR REACTIONS. Matsui, K. (Tohoku Univ., Sendai (Japan). Faculty of Engineering); Konno, O.; Ishino, S. Kakuriken Kenkyu Hokoku; 7: No. 1, 147-155(Jun 1974).

The optimum conditions of ^{73}Ga source preparation and Mössbauer scattering experiment for the 13.3 keV level of ^{73}Ge have been examined with the use of Ge(Li) low energy photon counter. (auth)

34873 CAPTURE GAMMA-RAY SPECTRA FOR THE ^{59}Co(n,γ)^{60}Co REACTION USING RESONANCE ENERGY NEUTRONS. Prestwich, W. V.; Lopez, A. M. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 53: No. 4, 351-359(15 Feb 1975).

Capture gamma-ray spectra for the reaction ^{59}Co(n,γ)^{60}Co were obtained for different neutron energy distributions. Significant contributions from the high energy resonances were observed. Analysis of the data for the ground state transition indicates that the contribution to the process from potential direct capture is substantially smaller than previous estimates. No retardation of transitions to final states exhibiting an $l_n = 3$(d,p) stripping pattern, such as that observed for 132 eV capture, is evident for the higher energy resonances. (auth)

34874 NEW THEORY OF INDUCED DISINTEGRATION OF NUCLEI. Battacharyya, A. K. (Inst. of Theoretical Physics, Calcutta). Indian J. Theor. Phys.; 22: No. 1, 1-20(Mar 1974).

The extension of the new theory of spontaneous alpha disintegration to the problem of nuclear reaction has yielded a result giving a new formula for the formation cross section of the compound nucleus when the target nucleus is bombarded by nucleons. The conception regarding the short range extra nuclear attractive field was introduced to explain the nuclear reactions when the energy of the incident nucleons (charged) is less than the peak value of coulomb potential. A new formula for formation cross section was derived for these nucleons, agreeing satisfactorily with the experimental results. The incidence of the charged particles having incident energy greater than the coulomb peak and of the uncharged particles was discussed as special cases. (auth)

34875 EXCITATION CURVES FOR FAST NEUTRON INDUCED REACTIONS ON ^{71}Ga, ^{75}As, ^{80}Se, ^{82}Se, ^{117}Sn, AND ^{118}Sn NUCLEI. Grochulski, W. (Univ., Warsaw); El-Konsol, S.; Marcinkowski, A. Acta Phys. Pol.; B6: No. 1, 139-145(1975).

Excitation curves for (n, 2n) reactions on the target nuclei ^{71}Ga, ^{75}As, ^{80}Se, ^{82}Se, ^{118}Sn, and for (n,p) reactions on the target nuclei ^{71}Ga, ^{75}As, ^{117}Sn, as well as for the ^{117}Sn (n,n') ^{117m}Sn reaction were measured in the neutron energy range 13–18 MeV. The results obtained were compared with the predictions of the compound nucleus and precompound emission models. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 34134, 34629, 34825, 34833, 34854, 34856, 34866, 34867, 34871, 34874, 34875, 34942, 34954, 34957, 34993, 35024, and 35047.

34876 (ANCR-1200) NUCLEAR STRUCTURE STUDIES UTILIZING LAMPF. Annual Progress Report. Reich, C. W.; Greenwood, R. C.; Helmer, R. G.; Gehrke, R. J.; Heath, R. L. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Jan 1975. Contract AT(10-1)-1375. 30p. Dep. NTIS $4.00.

A program has been funded to generate new nuclear structure information on nuclides off the line of beta stability. These data will be characterized and interpreted to test current theories in nuclear physics and to develop new concepts. To this end, studies are being made of radiations emitted in the decay of neutron-deficient and selected neutron-rich nuclides. Nuclides to be studied are produced primarily by proton-induced "spallation-type" reactions in the Los Alamos Meson Physics Facility (LAMPF). Progress reported includes work in three general categories: studies of the decay of selected radioactive nuclides, theoretical development of nuclear models to aid in the analysis and interpretation of experimental data, and the development of measurement techniques necessary for future work. Three sections of this report are indexed separately. (11 figures, 6 tables) (auth)

For title listings of selected papers see: 34877, 34878, and 34982.

34877 (ANCR-1200, pp 3-8) DECAY SCHEMES OF ^{128}Ba AND ^{128}Cs. Helmer, R. G.; Greenwood, R. C.; Gehrke, R. J.; Reich, C. W. Jan 1975.

In nuclear structure studies utilizing LAMPF.

34878 (ANCR-1200, pp 9-14) DECAY OF ^{131}Ba. Gehrke, R. J.; Helmer, R. G.; Reich, C. W.; Greenwood, R. C. Jan 1975.

In nuclear structure studies utilizing LAMPF.

34879 (ANL/HEP-75-02, pp XXI.1-XXI.19) USE OF POLARIZED BEAMS IN NUCLEAR PHYSICS. Haeberli, W. (Univ of Wisconsin, Madison). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

Examples of recent work on few-nucleon systems, spin dependence in the optical model, nuclear reactions, and the deuteron D-state effect are discussed as illustrations of polarization effects. (LBS)

34880 (CEA-N-1736) NUCLEAR DATA COMPILATION FOR THE INTERPRETATION OF GAMMA AND ALPHA SPECTROMETRY MEASUREMENTS. Barthe, J.-P.; Hairion, J.-P.; L'Homme, Alain; Noel, J.-P.; Panisset, J.-C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Dept. de Physique des Reacteurs et de Mathematiques Appliquees). Jul 1974. 12p. (In French). INIS.

A description is given of a nuclear data compilation which includes useful data for the most often observed nuclides in γ or α spectrometry performed on nuclear facilities. In this compilation 168 nuclides are indexed. It covers half-lives, α and γ radiation energies and intensities, and coincidence peaks and gives accuracies on these data. Yields, cumulated yields, and filiation are also given for some fission products. Recorded on magnetic disc, this compilation can be used in all the CEA centers. (FR)

34881 (COO-1779-111) ANOMALOUS ϵ/β^+ DECAY BRANCHING RATIOS. Firestone, R. B. (Michigan State Univ., East Lansing (USA). Dept. of Chemistry). 1974. 200p. Dep. NTIS $13.00.

Thesis.

ϵ/β^+ decay branching ratios were measured for decays from ^{143}Eu, ^{143}Sm, and ^{143}Gd. γ^+-γ triple coincidence experiments were performed to get relative positron feedings to respective daughter levels. X-γ coincidence measurements were done for ^{145}Gd decay to obtain relative electron capture feedings and these feedings were inferred from singles intensities for ^{143}Eu and ^{145}Sm decay. The decay schemes of ^{143}Eu and ^{143}Sm were also studied, and 12 levels were reported in ^{143}Pm as well as 16 levels in ^{143}Sm. Data were also gathered relevant to ^{140m}Pm decay and a β^+ endpoint for ^{66}Ga decay is reported. β decay theory is discussed in some detail, especially concerning the implications of ϵ/β^+ decay branching ratios. It is shown that anomalous ratios can only occur for higher order terms in allowed transitions or if a pseudoscalar force is present. Neither possibilities were hitherto eliminated experimentally. Among 15 measured ϵ/β^+ branching ratios, two were significantly anomalous. The transition to the 808.5 keV level in ^{145}Eu was anomalous by a factor of 24 and the transition to the 1173.1 keV level in ^{143}Pm was anomalous by a factor of 4.9. Each case involved a similar hindered allowed transition and it was suggested that the higher order allowed terms might be dominant in those instances. (auth)

34882 (COO-2318-7) SPECTROSCOPY OF NUCLEAR SYSTEMS. Progress Report, January 1–December 31, 1974. Macias, E. S. (Washington Univ., St. Louis, Mo. (USA)). 1974. Contract AT(11-1)-2318. 51p. Dep. NTIS $5.75.

The decay of ^{109}Sn, ^{107}Sn, ^{107m}In, ^{105}Sn, ^{97}Pd, ^{96}Pd, ^{140m}Pm, ^{140g}Pm, ^{141}Pm, ^{139}Pr, ^{89m}Nb, ^{89g}Nb, ^{143}Pm, ^{149}Eu, and ^{243}Cm was studied via γ-ray spectroscopy by using Ge(Li), Si(Li), and NaI(Tl) detectors. Direct and anti-Compton gamma-ray spectra, γ–γ and x-ray coincidence spectra were employed. A helium-jet recoil transport interfaced to a moving tape system was used to study short-lived nuclei. The energy, spin, parity and lifetimes of levels of ^{93}Mo were studied via the ^{93}Nb(p,nγ) and ^{94}Zr(α,2nγ) reactions by using in-beam γ-ray spectroscopy, Doppler shift attenuation, γ-ray angular correlation, and recoil distance methods. An on-line method for measuring transport time in a helium-jet system was developed. A simple fast sweeping system for extracted cyclotron beams is described. An electron gun for fabricating thin targets and a beta gauge for measuring target thickness are being developed. High-resolution on-line aerosol mass measurement by the beta attenuation technique is described. Four sections are indexed separately. (13 figures, 7 tables) (auth)

For title listings of selected sections see: 34883–34886.

34883 (COO-2318-7, pp 6-13) IDENTIFICATION OF 3-MIN ^{107}Sn AND 50-SEC 1/2$^-$ ISOMER OF ^{107}In. 1974.

In spectroscopy of nuclear systems.

34884 (COO-2318-7, pp 10-14) DECAY OF ^{105}Sn. Hseuh, H. C.; Macias, E. S. 1974.

In spectroscopy of nuclear systems.

34885 (COO-2318-7, pp 14-15) DECAY OF 10.8-MIN ^{105}Sn. Hseuh, H. C.; Macias, E. S. 1974.

In spectroscopy of nuclear systems.

34886 (COO-2318-7, pp 26-33) LIFETIME MEASUREMENTS OF LEVELS IN ^{93}Mo VIA THE RECOIL DISTANCE METHOD. Rutledge, L. L.; Macias, E. S.; Sarantites, D. G. 1974.

In spectroscopy of nuclear systems.

34887 (COO-3274-15) BACKBENDING AND DECOUPLED BANDS IN ^{126}Ba. Flaum, C.; Cline, D.; Sunyar, A. W.; Kistner, O. C.; Lee, Y. K.; Kim, J. S. (Rochester Univ., N. Y. (USA). Nuclear Structure Research Lab.; Brookhaven National Lab., Upton, N. Y. (USA); Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Physics). 9 Sep 1974. 21p. (CONF-740934-4). Dep. NTIS $4.25.

From international conference on nuclear structure and spectroscopy; Amsterdam, Netherlands (9 Sep 1974).

High spin states in ^{126}Ba were excited via the ^{114}Cd(^{16}O,4n) reaction using an 83-MeV ^{16}O beam from the BNL dual tandem Van de Graaff facility. Angular distributions and linear polarizations of the ^{126}Ba de-excitation gamma rays were measured and analyzed. Particle-plus-rotor-band mixing calculations were performed for two-quasiparticle configurations and were found to reproduce in a natural way both the positive and negative parity decoupled bands seen in ^{126,128}Ba, ^{156}Er, and ^{182}Hg. It is concluded that two-quasiparticle decoupled bands occur in these nuclei and strongly suggest that the backbending is primarily due to the crossing of such a decoupled, two-quasiparticle positive parity band and the ground state, zero-quasiparticle band. (LBS)

34888 (IPNO-T-74-12) ISOMER RATIO STUDY OF ^{134m,g}Cs, ^{135m,g}Cs AND ^{84m,g}Rb PRODUCED BY NUCLEAR REACTIONS IN ^{139}La AND ^{89}Y BOMBARDED BY p,d, ^{3}He AND ^{4}He. Krupa, J.-C. (Paris-11 Univ., 91 – Orsay (France). Inst. de Physique Nucleaire; Paris-6 Univ., 75 (France)). 1974. 118p. (In French). INIS.

A method for the separation of alkaline elements, carried out inside a surface ionization ion source of an electromagnetic separator or a mass spectrometer, is used to determine the isomer ratio of ^{84m,g}RB, ^{134m,g}Cs and ^{135m,g}Cs produced in ^{89}Y and ^{139}La targets bombarded with protons, deuterons, ^{3}He and alpha particles in the medium energy range from 40 to about 160 MeV. First, various information on the mechanisms of the interaction is obtained by studying the change in these ratios with the incident particle energy. Then a quantitative interpretation of these results is made on the basis of the statistical model, and comparison is made between the values obtained for the spin cut-off parameter and those deduced from the Fermi gas model. Finally, in order to investigate the angular momentum effect, proton- and α particle-induced reactions were compared. (FR)

34889 (JAERI-M-5567, pp 240-246) TECHNIQUES FOR SHORT-LIVED ISOTOPES WITH EMPHASIS ON CHEMICAL TREATMENTS. Fukushima, S. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

HI reactions are probably the most convenient way to produce n-deficient nuclides far from the β-stability line. Highly excited compound nuclei formed by a HI bombardment should decay via multi-particle emission processes, which make the product include various by-products over a wide range of atomic number. Therefore, in a HI reaction, measurements must be preceded by some chemical and/or mass separations. Importance of gas-phase separation is discussed for rapid techniques of order 10^0 sec. A rapid irradiation system used at the cyclotron of Osaka Univ. is explained, and a proposal is made for a "by-line chemistry station" provided with a "vertical beam duct" for RI production. (auth)

34890 (JAERI-M-5567, pp 284-289) COULOMB EXCITATION WITH HEAVY IONS. Sugiyama, Y. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Some of recent experimental results on Coulomb excitation are reviewed. In this review some of the difficulties with the method are stressed. (auth)

34891 (JINR-P6-8384) INVESTIGATION OF THE RADIOACTIVE DECAY OF ^{149}Gd. Aleksandrov, V. S.; Vylov, Ts.; Gromova, I. I.; Klyuchnikov, A. A.; Novgorodov, A. F.; Feoktistiv, A. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 21p. (In Russian). Dep. NTIS (US Sales Only) $4.25.

The γ-ray and conversion electron spectra were detected at the decay of ^{149}Gd. Information about 50 transitions (new data were obtained for 32 of them) is obtained. All the transitions are positioned in the decay scheme. The properties of the ^{149}Eu excited states are discussed. (auth)

34892 (ORO-4028-0021) RESEARCH IN NUCLEAR CHEMISTRY. Annual Progress Report. Viola, V. E. Jr.; Gordon, G. E.; Walters, W. B. (Maryland Univ., College Park (USA). Dept. of Chemistry). 1 Nov 1974. Contract AT(40-1)-4028. 80p. Dep. NTIS $7.00.

An outline of the research program is given in the introduction. There follow brief summaries of work done, organized under the topics radioactive decay studies, nuclear reaction and fission studies, developments of nuclear methods of analysis, and development of facilities. Lists of these, publications, talks, personnel, and acknowledgements are also included. (40 figures, 22 tables) (RWR)

For title listings of selected papers see: 34251, 34806–34808, 34893–34899, 34950–34953, 34965–34967, and 34993.

34893 (ORO-4028-0021, pp 4-11) DECAY OF ^{131m}Te AND ^{131g}Te. Jackson, S. V.; Walters, W. B.; Meyer, R. A. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34894 (ORO-4028-0021, pp 12-13) DECAY OF ^{133}Te ISOMERS. Meyer, R. A.; Landrum, J.; Jackson, S. V.; Zoller, W. H.; Walters, W. B. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34895 (ORO-4028-0021, pp 15-17) DECAY OF ^{105}Ru TO LEVELS OF ^{105}Rh. Schneider, E.; Mathews, G.; Jackson, S. V.; Walters, W. B. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34896 (ORO-4028-0021, pp 18-25) DECAY OF ^{105}Cd. Jackson, S. V.; Walters, W. B. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34897 (ORO-4028-0021, pp 26-29) DECAY OF ^{107}Cd. Jackson, S. V.; Meyer, R. A.; Walters, W. B. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34898 (ORO-4028-0021, pp 48-50) DECAY OF ^{128}Cs TO LEVELS OF ^{128}Xe. Graber, J.; Walters, W. B. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34899 (ORO-4028-0021, pp 93-112) SYSTEMATICS OF (x,x2p) REACTIONS FOR PRODUCTION OF NUCLEI "TWO PROTONS REMOVED FROM STABILITY." Colle, R.; Walters, W. B.; Zoller, W. H.; Dodge, W. R. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34900 ELASTIC AND INELASTIC ELECTRON SCATTERING FROM ^{142,146,150}Nd. Maas, R. Amsterdam; Instituut voor Kernphysisch Onderzoek (1974). 89p.

Thesis.

The elastic and inelastic cross sections of ^{142}Nd, ^{146}Nd and ^{150}Nd were measured relative to those of ^{12}C, at energies between 30 and 80 MeV. Ground-state charge-distribution parameter values c and t, obtained with the two-parameter Fermi distribution, are in the case of ^{146}Nd and ^{150}Nd in fair agreement with the results of muonic x-ray studies. The obtained rms-radius value of ^{142}Nd is about 2% larger. The present results do not confirm the findings of a high energy electron-scattering experiment in which very large t-values were deduced. Neither are the results of a low energy electron-scattering experiment, performed over a q-range comparable with that of the present experiment, in accordance with the present results: in this case extremely small t-values were deduced. The elastic cross sections of ^{150}Nd were also subjected to an analysis in which the ground-state charge distribution was assumed to be deformed. It turned out that the elastic data over the present q-range are not sensitive to the nuclear deformation. Charge-distribution parameter differences were deduced for ^{146}Nd–^{142}Nd, ^{150}Nd–^{142}Nd and ^{150}Nd–^{146}Nd. These differences indicate a 1.6% smaller value for the rms radius of ^{142}Nd than was found in previous muonic and electronic isotope-shift measurements. Inelastic form factors were measured for the first 2^+ and 3^- levels. Both the hydrodynamical and the Gauss model were used to deduce $B^{(EL)\dagger}$ -and R_{tr}-values. The two models give an equally good fit to the data. The obtained values with the Tassie model are systematically larger (7% and 3% respectively) than those obtained with the Gauss model. The dependence of R_{tr} and $B^{(EL)\dagger}$ on the width of the transition charge density and the ground-state charge-distribution parameters was investigated. (auth)

34901 NEUTRON CAPTURE CROSS SECTION OF ^{147}Nd. Heck, D.; Boerner, H.; Pinston, J. A.; Roussille, R. (Institut Max von Laue-Paul Langevin, 38-Grenoble (France)). Atomkernenergie; 24: No. 2, 141(1974).

To determine the burn up of reactor fuel elements it is sufficient to measure the number of atoms of a certain stable fission product. For a long time ^{148}Nd was considered to be a reliable fission product monitor, as its neutron capture cross section is low (approximately equal to 2.5 b) and the preceeding A = 148 mass chain members are short lived (<2 min). Recently it has been supposed that the ^{148}Nd fission product measurements are falsified by neutron capture in the 11.1 d ^{147}Nd with the conclusion that the unknown ^{147}Nd cross section might be in the 200 to 300 b region. An attempt is described to derive a value of the ^{147}Nd cross section, which enables more reliable corrections in burn up measurements. (INIS)

34902 HALF-LIFE OF ^{131}I. Karsten, J. H. M.; Marais, P. G.; Haasbroek, F. J.; Visser, C. J. (Fruit and Food Technology Research Inst., Stellenbosch (South Africa)). Agrochemophysica; 6: 25-26(1974).

With summary in Afrikaans and French.

The half-life of ^{131}I was determined on six different occasions. The possible effect of ^{131}Xe (half-life of 12 days) on the result is investigated but no influence was observed. Two methods were used to correct the resolving time losses in the counting system. Assuming that the resolving time of the counting system remains constant, a half-life of 8.020 ± 0.002 days was obtained. When, however, the relative efficiency method was used, a half-life of 8.031 ± 0.004 days was obtained. The latter is considered the most accurate result. (INIS)

34903 MEASUREMENT OF NEUTRON CAPTURE CROSS-SECTION IN THE RESONANCE REGION OF Pd, Ag, AND Ho. Yamamuro, N.; Yamada, K. (Tokyo Inst. of Tech. (Japan). Research Lab. of Nuclear Reactor); Kimura, I.; Fujita, Y.; Sakakibara, K. pp 34-40 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese).

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

The neutron capture cross section of Ag, Pd and Ho in the resonance region was measured by the pulse height weighting technique developed by Macklin et al., with an NE 226 liquid scintillator. The measurement of the neutron-detection efficiency of the liquid scintillator was carried out. A neutron source was ^{252}Cf, and fission neutron spectrum was obtained by the time of flight (TOF) method. The neutron capture cross section was measured by using the linear accelerator in the Research Reactor Institute of Kyoto University (KUR) as a neutron source. (JA)

34904 STUDY ON THE ERROR OF LUMPED CROSS SECTION SET OF FISSION PRODUCTS. Kikuchi, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). pp 92-101 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese).

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

It is important for the analysis of reactor characteristics such as burn-up calculation to know correctly the cross section of fission products. The nuclear constants of fission products are usually utilized in a lumped form weighted by yield ratio. The error problem of the lumped nuclear constants of fission products is discussed. The evaluation of the cross section of fission products is obliged to depend upon calculation because of the lack of experimental data. The Monte Carlo method is used in low energy region, the stochastic model is used in the high energy region, and there is a discontinuity or a high resonance peak appearing at the connecting point of two spectra in low and high energy regions. Therefore the lumped nuclear constants also show abnormal time dependence and abnormal energy dependence. In Cook's evaluation, for example, the abnormal discontinuity was found, which was not able to be described as statistical variation, and his evaluation method itself may be a mistake. On the other hand, the standard deviation of the group constants of fission products was proved to be reduced greatly by lump method. From these results, when the cross section of fission products is evaluated, it is recommended that the cross section in high energy region evaluated with a stochastic model should be extrapolated into low energy region. (JA)

34905 ^{8}Li FRAGMENTS FROM THE SPALLATION OF AgBr NUCLEI BY 60-GeV π^- MESONS. Aripov, R. (Physical-Technical Inst., Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 8, 18-21(1974). (In Russian).

The energy distribution and angular distribution of ^{8}Li fragments emitted during the bombardment of AgBr emulsions with 60-GeV mesons were measured. The kinematic characteristics of the fast and slow ^{8}Li fragments were calculated on the basis of the three-parameter evaporation model. (JSR)

34906 LEVELS IN ^{146}Sm POPULATED BY THE DECAY OF ^{146}Eu AND THE $(\alpha,2n)$, (d,t), AND $(^3He,\alpha)$ REACTIONS. Singh,

B.; Johns, M. W. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 53: No. 4, 391-410(15 Feb 1975).

The levels in ^{148}Sm were investigated through the electron capture of ^{148}Eu, and by means of the (α,2n), (d,t), and (^{3}He,α) particle reactions. Spins and parities of a large number of levels were determined by combining the results of $\gamma\gamma(\theta)$ and $\gamma(\theta)$ distributions in the electron capture and (α,2n) reactions respectively and electron spectra associated with the (α,2n) reaction. The low lying states of ^{148}Sm can be interpreted in terms of the vibrational model. The high spin states populated at higher excitation seem to be associated with particle excitations. (auth)

34907 DECAY OF ^{120}I. Lode, H. D. Brunswick; Technische Univ. (1972). 57p. (In German).

Thesis.

The half-life of the ground state of ^{120}I, T = (82.0 ± 0.2) min, and the energy and relative intensity of the ^{120}I-decay γ-quanta were measured using Ge(Li)-detectors and coincidence techniques. ^{120}I sources were prepared from Ce(p,5p xn)Xe, ^{120}Xe mass and ^{120}I chemical separation. The decay scheme and spin and parity of single levels are discussed using different nuclear models. (GE)

34908 STUDY OF THE REACTION ^{92}Zr(p,n)^{92}Nb WITHIN AND BEYOND AN ISOBARIC ANALOG RESONANCE. Schreiber, B. Berlin; Freie Univ. (1971). 62p. (In German).

Thesis.

The reaction ^{92}Zr(p,n)^{92}Nb was studied with the help of a time-of-flight device at beam energies E_p = 4.890, 4.998 and 5.066 MeV. With E_p = 4.998 MeV the isobaric analog state of the ^{93}Zr nucleus was excited in the ^{93}Nb compound nucleus. With a Ge(Li)-spectrometer the γ-decay after the (p,n)-reaction was measured for four different beam energies, for one of them also in coincidence with the emitted neutrons. Results of the measurements are the Q-value of the reaction ^{92}Zr(p,n)^{92}Nb $Q_{(pn)}$ = (−2,780 ± 10) keV, the Coulomb energy difference for the pair ^{93}Zr-^{93}Nb ΔE_c = (11,721 ± 15) keV and excitation energies for newly discovered states of the final nucleus ^{92}Nb. A γ-decay scheme is proposed for the range investigated. (GE)

34909 DECAY OF ^{147}Nd. Rangacharyulu, C. (Indian Inst. of Tech., Kanpur); Chaturvedi, S. N.; Mehta, G. K.; Nath, N. Aust. J. Phys.; 27: No. 6, 869-877(Dec 1974).

An experimental level scheme was determined for ^{147}Pm from an investigation of the decay of ^{147}Nd which employed a high resolution Ge(Li) detector and a sum-coincidence spectrometer with fast-slow coincidence. Conclusive evidence is presented for the existence of levels in ^{147}Pm at 182, 228.5, 275, 319.5, and 725 keV besides the six already established levels, while no evidence is found for another six levels suggested by some earlier workers. Thirty-two γ-ray transitions and their cascade relations were established, and relative intensities were determined for most of the transitions. (auth)

34910 FORM FACTOR OF THE β-SPECTRUM OF ^{99}Tc. Reich, M.; Schuepferling, H. M. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Strahlenphysik). Z. Phys.; 271: No. 2, 107-113(Dec 1974). (In German).

The β-spectrum of the second non-unique forbidden $\frac{9}{2}^+$-$\frac{5}{2}^+$ transition in the decay of ^{99}Tc has been investigated with a 4π-Si(Li)-semiconductor-spectrometer. The form factor has been determined: $S(W) = k(1 - 3.97\,W + 1.15/W + 3.05\,W^2)$. It was also possible to fit the data with the normal xi-approximation to the theoretical form factor $S(W) = k(q^2 + 0.54\,p^2)$. The second forbidden 2^+-0^+ β^--transition in the decay of ^{36}Cl was reinvestigated to test the spectrometer as well as the fitting-technique. (auth)

34911 E3 ISOMERS OF ^{93}Y AND ^{101}Ag. Casella, V. R.; Knight, J. D.; Naumann, R. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Phys., A; 239: No. 1, 83-88(17 Feb 1975).

The half-lives of the E3 isomeric levels in ^{93}Y (at 758 keV) and in ^{101}Ag (at 273 keV) have been found to be 0.82 ± 0.04 s and 3.12 ± 0.12 s, respectively. The single-particle hindrance factors, about 3.5 and 70, are discussed. (auth)

34912 DOPPLER MEASUREMENTS OF RECOIL MOMENTA FROM NUCLEAR ABSORPTION AT REST. Lewis, C. W. (Karlsruhe Univ. (TH) (F.R. Germany). Inst. fuer Experimentelle Kernphysik). Nucl. Instrum. Methods; 123: No. 2, 289-294 (15 Jan 1975).

The relationships between Doppler-broadened γ-ray line shapes and recoil momentum distributions from nuclear absorption (of pions, muons, etc.) at rest is investigated. The results take account of the slowing down of the recoils due to electronic and nuclear stopping, and thus generalize previous results valid only for very short γ-ray emission lifetimes. A discussion of angular correlation effects is also given. (auth)

34913 INTENSITIES OF γ- AND X-RAYS IN THE ^{125}I DECAY. Pich, J.; Zderadicka, J. (Inst. for Research, Production, and Application of Radioisotopes, Prague). Czech. J. Phys.; B24: No. 12, 1311-1313(1974).

Total number of x- and γ-rays per decay equal to 1.4785 ± 0.009 was determined by means of the coincidence measurement in the windowless 4π scintillation counter. The coincidence measurement with Si(Li) and scintillation counters gave $P_K\omega_K$ = 0.685 ± 0.012. (auth)

34914 LIFETIMES OF THE EXCITED LEVELS OF ^{93}Nb. Erokhina, K. I.; Zhirgulyavichyus, R. K.; Lemberg, I. Kh.; Pasternak, A. A. (Ioffe Inst. of Physics and Tech., Leningrad). Liet. Fiz. Rinkinys; 14: No. 4, 591-599(1974). (In Russian).

The Doppler-shift attenuation method was used to measure the lifetimes of ^{93}Nb excited levels populated via Coulomb excitation of ^{93}Nb with 44.0 MeV ^{14}N ions. The measured lifetimes are: (0.80 ± 0.15) ps for 742 keV and (0.34 ± 0.06) ps for 980 keV levels of ^{93}Nb. Lifetime values for 809 and 952 keV levels were estimated to be more than 2 ps each. Multipolarity mixing parameters δ and B(Ml) ↓ values were deduced for the transitions from the 742 and 980 keV levels to the ground state of ^{93}Nb. (auth)

34915 CROSS SECTIONS OF ^{115}In AND ^{176}Lu FOR THE (γ,γ') REACTIONS. Yoshihara, K. (Tohoku Univ., Sendai (Japan). Faculty of Science). Kakuriken Kenkyu Hokoku; 7: No. 1, 190-193(Jun 1974). (In Japanese).

Cross sections of ^{115}In and ^{176}Lu for the (γ,γ') reactions were measured using an electron linear accelerator. The values of the integrated cross section at 1078 keV were compared among the results of previous work. (auth)

34916 EXCITED STATES OF ^{135}La POPULATED BY THE DECAY OF ^{135}Ce. Nagai, Y.; Hisatake, K. (Tokyo Inst. of Tech. (Japan)). J. Phys. Soc. Jap.; 36: No. 6, 1501-1509(Jun 1974).

The decay of ^{135}Ce was studied with a $\pi\sqrt{2}$ iron-free β-spectrometer, a Ge(Li) detector and an e^--γ delayed coincidence technique. From internal conversion and γ-ray studies 21 new transitions were observed. The multipolarities with mixing ratios of 10 transitions were determined from the L-subshell conversion ratios. From these results a revised decay scheme is proposed as follows: 0[$\frac{5}{2}^+$], 119.47[$\frac{7}{2}^+$], 206.37[$\frac{5}{2}^+$], 265.42[$\frac{3}{2}^+$], 299.92[$\frac{1}{2}^+$], 665.30[$\frac{5}{2}^+$], 783.38[$\frac{3}{2}^+$], 828.20[$\frac{3}{2}^+$], 872.15[$\frac{1}{2}^+$($\frac{3}{2}^+$)], 984.29[$\frac{7}{2}^+$, $\frac{3}{2}^+$], 1171.16[$\frac{3}{2}^+$($\frac{1}{2}^+$)], 1438.95[$\frac{1}{2}^+$,$\frac{3}{2}^+$] and 1767.3[$\frac{1}{2}$,$\frac{3}{2}$], where level energies are written in keV. Large E2 enhancements are found for the 34.5, the 86.9, the 265.4 and the 299.9 keV transitions. (auth)

34917 EFFECT OF FINITE RESOLUTION ON CONTINUOUS NEUTRON SPECTRA. Chevarier, A. (Univ. Claude Barnard, Lyon); Chevarier, N.; Duma, M.; Magda, M. T. Rev. Roum. Phys.; 19: No. 10, 1045-1051(1974). (In French).

An iteration method was developed in order to study the distortion of the continous neutron spectra caused by the finite resolution of the time-of-flight spectrometer. This calculation technique was used in the case of neutron spectra measured during reactions induced by ^{3}He. The possibilities and limitations of the method are examined. (tr-auth)

34918 DOUBLE-PHOTON DECAY IN ^{90}Zr NUCLEUS. Asano, Y. New York; Columbia Univ. (1974). 109p. University Microfilms Order No. 75-7473.

Thesis (Ph. D.).

Double-photon decay in the 0^+ to 0^+ transition in ^{90}Zr was measured with two large-volume Ge(Li) detectors, at angles of 90 and 180°. An extensive search for the background impurities revealed the contamination of 1.765 MeV nuclear gamma rays in the transition of ^{214}Bi, which is present in the room surroundings and the lead shielding blocks. The intensity of the 1.765-MeV background was over 30% of that of the total two-photon decay. The electronics set-ups which were used in this experiment consist of fast-slow coincidence circuits, a summing amplifier, and a 1600-channel ADC. With a 15 year old radioactive ^{90}Sr source contained in a small cylindrical Be container, double-photon emission was measured for 30 days for 90° and 60 days for 180°. The branching ratio obtained in this experiment, (3.17 ± 0.77) × 10^{-4}, is slightly larger than the upper limit reported by some other workers and smaller than another value reported, although it is not in serious disagreement with either of them. The angular correlation of two-photons is in agreement with that of (E1,E1) transition, although it does not exclude other possibilities. The theoretical work on the double-photon decay in ^{90}Zr is briefly reviewed, and it is found that at present there is no accurate calculation of the branching ratio of double-photon decay which is consistent with the wave functions determined by the monopole transition rate. Using the branching ratio obtained in this experiment, the lifetime of the 1^- states in the region

of the giant resonance states is estimated to be about 3×10^{-18} sec. (Diss. Abstr. Int., B)

34919 DECAY OF ^{96m}Rh AND ^{96}Rh. Gujrathi, S. C.; Weiffenbach, C.; Lee, J. K. P. (McGill Univ., Montreal). J. Phys. G, Nucl. Phys.; 1: No. 1, 67-76(10 Jan 1975).

The decay properties of ^{96g}Rh ($T_{\frac{1}{2}}$ = 9.90 ± 0.10 min) and ^{96m}Rh ($T_{\frac{1}{2}}$ = 1.51 ± 0.02 min) produced by the ^{96}Ru(p, n) reaction on enriched targets have been studied using Ge(Li) and plastic detectors. A total of 80 γ rays have been assigned to follow the decay of these two isomers. Gamma-gamma and beta-gamma coincidence measurements were made. The J^π assignments of 2^+ for ^{96}Ru and 5^+ for ^{96g}Rh have been proposed. A 52.0 ± 0.1 keV M3 isomeric transition with 60 ± 5% branching ratio has been identified. Decay schemes for ^{96g}Rh and ^{96m}Rh have been proposed. (auth)

34920 LIFETIME OF THE 410 keV LEVEL OF ^{147}Pm. Sinha, B. K.; Sen, S.; Bhattacharyya, R. (Saha Inst. of Nuclear Physics, Calcutta). J. Phys. G, Nucl. Phys.; 1: No. 1, 92-94(10 Jan 1975).

The lifetime of the 410 keV level of ^{147}Pm is measured by the delayed coincidence technique using a time-to-amplitude converter. The result is τ = 201 ± 20 ps. (auth)

34921 SPIN VIBRATION STATES IN ^{120}Sn AND ^{208}Pb WITHIN ΔN = 0 AND ΔN = 2 OSCILLATOR SHELLS. Cwiok, S. (Technical Univ., Warsaw); Wygonowska-Haensel, M. Acta Phys. Pol.; B6: No. 1, 105-111(1975).

Energies, wave functions, and M1 electromagnetic transition widths have been calculated for ^{120}Sn and ^{208}Pb with the use of the Saxon-Woods potential and of "realistic" residual forces. The excitations within three neighboring oscillator shells have been taken into account. Excited states $J^\pi = 1^+$ in the energy region 3.2-20.7 MeV have been obtained. They can be called spin vibration states, consisting mainly of excitations within one oscillator shell. (auth)

34922 DECAY OF THE 23 MIN ^{131}Sb. Hnatowicz, V.; Kristak, J.; Fiser, M.; Venos, D.; Jursik, J. (Inst. of Nuclear Physics, Prague). Czech. J. Phys.; B25: No. 1, 1-9(1975).

The direct and the coincidence spectra of gamma-rays from the ^{131}Sb decay have been measured by means of different Ge(Li) detectors. The Sb sources have been prepared from mixture of ^{235}U thermal neutron fission products. The proposed level scheme of the ^{131}Te nuclei is based on the coincidence measurements, the analysis of the energy sums and the reaction data. The 49 of the total number of 64 gamma-rays observed have been placed in the present decay scheme. Properties of the same levels in ^{131}Te are compared with those observed in other odd-mass Te isotopes. A probable structure of some of the excited states in ^{131}Te is discussed. (auth)

34923 NUCLEAR DATA SHEETS FOR A = 116. Carlson, G. H. (Ames Lab., IA); Talbert, W. L. Jr.; Raman, S. Nucl. Data Sheets; 14: No. 3, 247-296(Mar 1975).

The 1960 version of the Nuclear Data Sheets for A = 116 was revised on the basis of experimental data received before August 1973, with some later modifications received via private communications. Experimental data concerning the nuclear structure of ten isotopes were compiled and used in the construction of the level schemes and J^π assignments. (auth)

34924 NUCLEAR DATA SHEETS FOR A = 146. Burrows, T. W. (Univ. of Kentucky, Lexington). Nucl. Data Sheets; 14: No. 4, 413-470(Apr 1975).

The 1967 version of the Nuclear Data Sheets was revised on the basis of experimental data received by January 31, 1974. Pertinent data received between January 31 and May 31, 1974, were added in proof. The A = 146 chain consists of 11 nuclei (Cs through Tb). Four of these nuclei (Cs, Ba, La, and Tb) have been assigned since 1969. Tentative level or decay schemes were assigned to three of these new nuclides (Ba, La, and Tb). Several discrepancies in the data and other problems associated with the construction of the present level schemes are pointed out in the Comments. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 34850, 34867, 34900, 34903, 34915, 34953, 34954, and 35001.

34925 (BNL-19455) EVALUATION OF THE NEUTRON AND GAMMA-RAY PRODUCTION CROSS SECTIONS OF ^{151}Eu AND ^{153}Eu. Takahashi, H. (Brookhaven National Lab., Upton, N. Y. (USA)). Nov 1974. 28p. (ENDF-213). Dep. NTIS $4.50.

The evaluation of neutron and gamma-ray production cross sections for ^{151}Eu and ^{153}Eu at intermediate and high energies is summarized. (LBS)

34926 (BNL-19456) EVALUATION OF THE NEUTRON CROSS SECTION FOR ^{152}Eu AND ^{154}Eu. Takahashi, H. (Brookhaven National Lab., Upton, N. Y. (USA)). Nov 1974. 18p. (ENDF-214). Dep. NTIS $4.00.

The evaluated results for the neutron cross sections for ^{152}Eu and ^{154}Eu are presented. The evaluations were mostly carried out by nuclear model calculations. These data have been compiled in the format of ENDF/B-IV. (LBS)

34927 (INS-J-146) NEW ASPECT OF THE QUASI-GAMMA BAND. Sakai, M. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 19 Apr 1974. 26p. INIS.

Quasi-γ band up to the 7^+ member newly found in ^{126}Xe gives a deep insight in the relationship between the phonon model and the rotational model. B(E2) ratios of interband transitions, energy spacing of band members and energy relation between the quasi-γ and quasi-ground bands are studied by use of known data in the literature together with the present data. It is revealed that the nuclear properties of the quasi-γ band are in many aspects common to those of the γ band in the deformed region. They are also discussed in connection with those of the second yrast members of phonon levels. (auth)

34928 (JINR-E6-8327) THE G-FACTORS OF THE FIRST AND SECOND EXCITED STATES IN ^{151}Gd. Afanasiev, V. P.; Budzynski, M.; Demeter, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 17p. Dep. NTIS (US Sales Only) $4.00.

Measurements of the integral perturbed angular correlation (IPAC) were made using magnetic hyperfine interactions. The ^{151,153}Tb radioactive nuclei were embedded in iron foil by the use of an isotope separator. The measurements of the g-factors have yielded for 108-keV state in ^{151}Gd a value of (−0.69 ± 0.17) and for 395 keV state a value of (−1.49 ± 0.41) or (−0.90 ± 0.27). (auth)

34929 (JINR-P6-8419) IDENTIFICATION OF ^{158}Yb, $T_{\frac{1}{2}}$ = (1.1 ± 0.2) MIN. Gliev, V. I.; Gonucek, M.; Gromov, K. Ya.; Lyatushinski, A.; Penev, I.; Potempa, A. V.; Ziebert, Kh. U.; Zuber, Ya.; Zuber, K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 9p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

On the basis of the analysis of gamma-spectrum of A = 158 isobars we have first reliably identified the ^{158}Yb isotope. Its half-life $T_{\frac{1}{2}}$ = (1.1 ± 0.2) min. has been measured. The ^{158}Yb decay is followed by the emission of gamma-rays with energy of (74.2 ± 0.2) keV. (auth)

34930 (UCRL-51306(Rev. 1)) EVALUATED DATA SET FOR TANTALUM. Howerton, R. J.; Haight, R. C.; MacGregor, M. H.; Perkins, S. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 27 Feb 1975. Contract W-7405-eng-48. 30p. Dep. NTIS $4.00.

The methods used to obtain cross sections and angular and energy distributions for neutron-induced reactions and gamma-ray, x-ray, and conversion-electron production are described for ^{181}Ta. (14 figures, 3 tables, 106 references) (auth)

34931 OPTICAL METHODS IN DETERMINATION OF NUCLEAR PARAMETERS. Kopystynska, A. (Univ., Warsaw). Postepy Fiz.; 25: No. 5, 497-516(1974). (In Polish).

Application of optical methods to determination of nuclear spin, magnetic dipole moment, electric quadrupole moment and deformation parameter β is presented. General information about optical pumping and description of the experiment on optical pumping of neutron deficient isotopes of mercury is reported. (auth)

34932 PHENOMENOLOGICAL DESCRIPTION OF ROTATIONAL SPECTRA IN ODD NUCLEI BY THE ANGULAR MOMENTUM PROJECTION METHOD. Mai, F. R.; Myunkhov, L.; Frauendorf, S. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 20: No. 5, 873-882(Nov 1974). (In Russian).

Starting from a phenomenological description of rotational ground state bands in even-even nuclei one finds in the case of deformed odd-mass nuclei a four-parameter formula for the spectra by means of the angular momentum projection method. This formula works for rotational states with large angular momentum as well as for quasi-rotational bands. As a result one obtains rotational bands in good accordance with experiment. The interpretation of the model is discussed. (auth)

34933 ISOMER STATE ^{187m}Ir AND ITS DECAY SCHEME. Romanii, I. A.; Klyucharev, A. P.; Lutsik, V. A.; Rakivnenko, Yu. N.; Yatsenko, G. I. (Physical-Technical Inst., Tashkent). Yadern. Fiz.; 20: No. 5, 841-845(Nov 1974). (In Russian).

Spectrum of inner-conversion electrons accompanying the

decay of the isomer state ^{187m}Ir produced in the reaction ^{185}Re (α, 2n) ^{187m}Ir is measured by means of a double air-core β spectrometer ⟨⟨Orange⟩⟩. The isomer half-life period ($T_{\frac{1}{2}}$ = 30.3 ± 0.6 msec) is measured from the decrease of intensity of the conversion lines, as well as the excitation function for the reaction producing this isomer. The conversion lines are detected corresponding to the transitions: 186.6 ± 0.3 keV, type E3, K/L = 0.214 ± 0.015; 110.2 ± 0.2 keV, type M1 + (32 ± 3)% E2, K/L = 2.76 ± 0.17; and 76.6 ± 0.3 keV type M2. The relative intensities of the electron lines are measured and the transition intensities are calculated. Based on the obtained experimental data a decay scheme is presented for the isomer ^{187m}Ir. The energy of the isomer level $^{9}/_{2}^{-}$ is 186.6 ± 0.3 keV. (auth)

34934 LIFETIMES OF THE $^{3}P_{1}^{0}$ LEVEL OF Yb I AND THE $^{2}P_{\frac{1}{2},\frac{3}{2}}^{0}$ LEVEL OF Yb II. Burshtein, M. L.; Verolainen, Ya. F.; Komarovskii, V. A.; Osherovich, A. L.; Penkin, N. P. Opt. Spectrosc. (USSR) (Engl. Transl.); 37: No. 4, 351-352(Oct 1974).

Translated from Opt. Spektrosk.; 37: No. 4, 617-620(Oct 1974).

The lifetimes of 6s6p $^{3}P_{1}^{0}$YbI ($\tau_{^{3}P_{1}^{0}}$ = 850 ± 80 nsec), $6p^{2}P_{\frac{3}{2}}^{0}$ YbII ($\tau_{^{2}P_{\frac{3}{2}}^{0}}$ = 8.9 ± 0.5 nsec), and $6p^{2}P_{\frac{1}{2}}^{0}$YbII ($\tau_{^{2}P_{\frac{1}{2}}^{0}}$ = 7.3 ± 0.6 nsec) levels are measured using the delayed coincidence method. The lifetime of the $7s^{2}S_{\frac{1}{2}}$YbII ($\tau_{^{2}S_{\frac{1}{2}}}$ = 30 nsec) is estimated on the basis of observations of the cascade population of the $6p^{2}P_{\frac{1}{2}}^{0}$YbII level. (auth)

34935 BETA-DELAYED ALPHA-PARTICLE EMISSION IN THE DECAY OF 3.6s ^{181}Hg. Hornshoej, P.; Wilsky, K. (Aarhus Univ. (Denmark)); Hansen, P. G.; Jonson, B. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 55: No. 1, 53-55(20 Jan 1975).

The emission of α-particles with energies between 10 and 12 MeV has been observed in the decay of ^{181}Hg in an intensity of $(9 \pm 3) \times 10^{-4}$. These events are taken to represent β-delayed α-particle emission from levels at 4-6 MeV excitation energy in ^{181}Au and provide an estimate of the α-strength function for this excitation energy. The results are discussed in terms of an α-particle cluster model. As a by-product the experiment gives new values for the α-particle branching ratios of ^{181}Hg and ^{181}Au: 0.26 ± 0.04 and 0.011 ± 0.0025. (auth)

34936 DECAY OF THE THREE ISOMERS OF ^{154}Tb. Sousa, D. C.; Riedinger, L. L.; Funk, E. G.; Mihelich, J. W. (Notre Dame Univ., Ind. (USA)). Nucl. Phys., A; 238: No. 3, 365-408 (10 Feb 1975).

The decays of the three isomers of ^{154}Tb(9.0 h, $I^{\pi} = 3^{+}$; 21.4 h, $I^{\pi} = 0^{+}$; and 22.6 h, $I \geq 7$) have been studied using Ge(Li) and Si(Li) detectors in singles and coincidence. Although isomeric transitions proceed between these states, only an upper limit may be set for the intensity of K x-rays of Tb. Over 300 γ-rays have been observed and over 78 new levels have been proposed, on the basis of γ-ray and internal conversion electron measurements, $\gamma-\gamma$ coincidence and half-life measurements on sources produced in various reactions. The ground-state rotational band up to the 8^{+} state is observed, as well as the 0^{+}, 2^{+}, and 4^{+} states of the β-band at 680.7 keV. The 5^{+} and 6^{+} members of the γ-vibrational band are proposed as well as the 4^{+}, 5^{+}, and 6^{+} members of a $K = 4^{+}$ band, based at 1645.9 keV. A $K^{\pi} = 0^{+}$ two-phonon band at 1295.8 keV is proposed; Meyer places it at 1292.8 keV. A $K^{\pi} = 1^{-}$ band (2^{-}, 1^{-}, 4^{-}, 3^{-} states) at 1397.6 keV and a $K^{\pi} = 2^{-}$ band at 1719.9 keV are in essential agreement with the results of Meyer obtained in the ^{154}Eu decay, although a different 1^{-} state is proposed for the $K^{\pi} = 1^{-}$ band. The data are consistent with Meyer's assignment of a $K^{\pi} = 0^{-}$ band (1^{-} and 3^{-} states) at 1241.3 keV. Ratios of reduced E2 transition probabilities for transitions from previously unobserved members (5^{+} and 6^{+}) of the $K^{\pi} = 2^{+}$ one-phonon gamma-vibrational band and the $K^{\pi} = 4^{+}$ band at 1645.9 keV were obtained and compared with theoretical predictions. Nilsson orbital assignments for various states are discussed. (auth)

34937 THEORETICAL STUDY OF THE ^{167}Ho → ^{167}Er BETA DECAY. Bogdan, D. (Inst. of Atomic Physics, Bucharest); Cretu, T.; Macarie, G. Rev. Roum. Phys.; 19: No. 10, 1077-1088(1974).

The absolute ft values for the beta rays emitted by the ^{167}Ho nuclei were calculated. The Coriolis forces being taken into account in the nuclear hamiltonian a good agreement with the experiment was achieved for the first forbidden transitions. For the allowed transitions the multipole-multipole forces effects were considered, and important polarization amplitudes were determined from the experimental ft values. (auth)

34938 CASCADE ANGULAR CORRELATION IN THE ^{177}Lu GROUND STATE BAND AND CORRECTIONS TO THE UNIFIED MODEL. Venezia, F. P. Bloomington, IN; Indiana Univ. (1974). 94p. University Microfilms Order No. 75-9002.

Thesis (Ph. D.).

The nuclear level schemes of both ^{175}Lu and ^{177}Lu have been known for some time. Since the two nuclides are similar except for an extra pair of neutrons in ^{177}Lu one would expect their level structure to be similar. Both have a similar ground state rotational band built on the [404↓] Nilsson state but the [514 ↑] Nilsson states are quite different in energies. This difference is interesting to investigate in terms of the Bohr, Mottelson, and Nilsson unified model. Since the ^{177}Lu ground state rotational band has not been extensively studied, use is made of angular correlation to obtain parameters of the unified model. The angular correlation being investigated is between the first two members of the ground state band. Two Ge(Li) detectors in a slow-fast coincidence arrangement with a fast coincidence of approximately 15 nsec were used. An energy "window" is set on the amplified output of one of the detectors while the coincidence spectrum of the other is recorded in a 1600 channel multi-channel analyzer. This recorded spectrum is then analyzed on the CDC 6600 computer at Indiana University. The angular correlation is then obtained from the data of a series of "runs" taken with the two detectors at different relative angles to each other using a least square fitting program on a Digital PDP 8 computer in this laboratory. The difference of the single particle energies and intrinsic magnetic parameter g_K of the nuclides are investigated by means of the introduction of a δ-function type neutron-proton interaction into the Nilsson-Hamiltonian as a first perturbing term. The new Nilsson single particle energies and intrinsic magnetic parameter g_K agree well with the experimental results. (Diss. Abstr. Int., B)

34939 NUCLEAR DATA SHEETS FOR A = 173. Harmatz, B.; Horen, D. J. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 14: No. 3, 297-346(Mar 1975).

The available experimental results for nuclei in the mass chain A = 173 are summarized. The evaluated data are compared with theory, where possible, and arguments for spin, parity, and Nilsson-state assignments are given. A probable discontinuity in the Nilsson ground-state systematics is noted for tantalum, consistent with strong beta transitions to a $\frac{1}{2}^{-}$[521] configuration in ^{173}Hf. Similar decay properties were observed for ^{171}Ta. Data received prior to October 1974 are included. (auth)

34940 NUCLEAR ORIENTATION AND ANGULAR CORRELATION STUDIES OF GAMMA RAY CASCADES IN ^{155}Gd POPULATED BY THE DECAY OF ^{155}Tb. Warner, D. D.; Hamilton, W. D.; Fox, R. A.; Finger, M. (Univ. of Sussex, Eng.). J. Phys. G, Nucl. Phys.; 1: No. 1, 95-112(10 Jan 1975).

The low-lying positive-parity levels in ^{155}Gd have been investigated using the two complementary techniques of directional correlation and directional distribution of radiation emitted by an oriented source. The orientation was produced using the hyperfine field in ferromagnetic gadolinium to polarize an ensemble of ^{155}Tb nuclei at temperatures below 10 mK. The resultant directional distribution of γ rays de-populating levels below 488 keV was measured using higher resolution Ge detectors. The correlation measurements used a NaI(Tl) or an intrinsic Ge detector in combination with a Ge(Li) detector. Most of the cascades investigated contained either the 86 or 105 keV E1 transition to the ground state. Thus the γ ray of interest was the first member of the cascade in the coincidence measurement. In the case of the nuclear orientation measurements, the γ ray was the second member of the cascade. This effective reversal of temporal order produces two unique values for the coefficient describing the transition, which, in this case, is almost always an E2/M1 admixture. Comparison of the two coefficients for a given γ ray often enables unambiguous spin assignments to be made. In addition, the mixing ratios involved can be deduced. The decay scheme is discussed and experimental results are compared with the band mixing calculations of Lovhoiden et al. (Nucl. Phys.; A148: 657 (1970)). (auth)

34941 LOW ENERGY TRANSITIONS IN THE DECAY OF ^{155}Tb. Christmas, P.; Cross, P. (National Physical Lab., Teddington, Eng.). J. Phys. G, Nucl. Phys.; 1: No. 1, 113-119(10 Jan 1975).

Internal conversion electrons of low energy from the decay of 5.6 day ^{155}Tb have been studied using a high-resolution, iron-free β-ray spectrometer. The existence of a 10.49 keV transition has been confirmed. (auth)

34942 RESONANCE INTEGRALS OF ^{63}Cu, ^{65}Cu, ^{107}Ag, ^{159}Tb, ^{164}Dy, AND ^{165}Ho. Ryves, T. B.; Zieba, K. J. (National Physical Lab., Teddington, Eng.). J. Phys., A (London); 7: No. 18, 2318-2332(11 Dec 1974).

The reduced resonance integrals were measured by an activation technique using cadmium ratios, relative to two standard materials, manganese and gold. The use of two reference standards corrects for small deviations in the neutron slowing down spectrum from a 1/E dependence per unit neutron energy E. Results obtained were ^{63}Cu: 2.79 ± 0.18 b, ^{65}Cu: 1.22 ± 0.06 b,

^{107}Ag: 79 ± 4 b, ^{159}Tb: 390 ± 24 b, ^{164}Dy: –514 ± 115 b and ^{165}Ho: 618 ± 33 b, where the uncertainities are estimated at approximately the 99% confidence level, and include an uncertainty of ±4% in the reference standards. It was necessary to measure the half-lives of the activities produced, giving ^{64}Cu: 12.704 ± 0.006 h, ^{66}Cu: 5.13 ± 0.03 min, ^{108}Ag: 2.37 ± 0.01 min and ^{166}Ho: 26.83 ± 0.03h, and also the 2200 ms^{-1} neutron capture cross sections of ^{159}Tb: 23.2 ± 0.5 b, ^{165}Ho: 61.2 ± 1.1 b and ^{107}Ag: 37.6 ± 1.2 b (re-evaluated from the new-life). (auth)

34943 NUCLEAR DATA SHEETS FOR A = 182. Schmorak, M. R. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 14: No. 4, 559-600(Apr 1975).

The available experimental data pertaining to the nuclear structure of nuclei with A = 182 are compiled; the results from various decay and reaction measurements are compared and evaluated. Inconsistencies and discrepancies in the level schemes are discussed. The "Level Properties" section in the Summary Sheets contains the most complete information on level energies, J^{π} and $T_{\frac{1}{2}}$. Level schemes for each of the A = 182 nuclei are presented first. Then, for each nucleus, are presented summaries of level properties and compilers' comments, followed by the experimental data and a reference list. Data received before September 1974 are included. (auth)

34944 NUCLEAR DATA SHEETS FOR A = 187. Ellis, Y. A. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 14: No. 3, 347-411(Mar 1975).

The available nuclear structure information for all nuclei with mass number A = 187 is presented. Data from various decay and reaction experiments are compared. Evaluated data and arguments for spin, parity, and Nilsson-state assignments are given. Inconsistencies and discrepancies are indicated. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 34856, 34866, 34892, 34921, 34975, and 34993.

34945 (CEN-TS-74-1) STUDY OF PROJECTILE–TARGET INTERACTION PROCESSES AROUND THE COULOMB BARRIER: BREAKUP IN FLIGHT OF THE PROJECTILE; ELASTIC AND INELASTIC SCATTERING. Sousbie, G. (Bordeaux-1 Univ., 33 – Gradignan (France). Centre d'Etudes Nucleaires; Bordeaux-1 Univ., 33 (France)). 1974. 59p. (In French). INIS.

Inelastic effects in heavy-ion scattering are studied in two different ways. The first one refers to inelastic processes as an intermediate mechanism in the breakup in flight of a projectile in multinucleon transfer. The second one is related to destructive effects occurring in the behavior of the inelastic cross section around the Coulomb barrier. An important theoretical and experimental analysis is done in the first part of the work on the breakup in flight of ^{7}Li in the reaction ^{7}Li + ^{197}Au between 27 MeV and 46 MeV. The aim was to know whether a virtual or real excitation energy is involved in ^{7}Li before break-up or transfer of some of its nucleons. The experimental results are in favor of a selectivity of the ^{6}Li* (3^{+}) + n structure against the weakly bound α + t structure. The virtual energy is 10.4 MeV in the projectile + target system. In the second part, the simultaneous effects of Coulomb and nuclear potentials are analyzed in terms of DWBA and coupled channel calculations in order to understand the lowering in the inelastic cross section, to measure the collective deformation parameters and to have a good knowledge of the optical potential parameters. (FR)

34946 (CONF-750118-2) REACTION TIMES FOR "QUASI-FISSION" AND ON THE CRITICAL DISTANCE CONCEPT IN HEAVY-ION FUSION REACTIONS. Plasil, F. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 10p. Dep. NTIS $4.00.

From international workshop III on gross properties of nuclei and nuclear excitations; Hirschegg, Kleinwalsertal, Austria (13 Jan 1975).

By considering reaction times as obtained from rotation times, it is shown that the assumption that a tendency toward mass equilibrium implies longer reaction times is reasonable and that the results for the angular distributions for copper reactions with gold and krypton reactions with bismuth are not in contradiction. Also the sudden approximation is used to show that the critical distance concept cannot at this point be applied to obtain reliable predictions of fusion cross sections. (JFP)

34947 (JAERI-M-5567, pp 262-266) HEAVY ION REACTIONS FOR HEAVY NUCLEI. Shida, K. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Some of topics on incomplete fusion and the direct process are reviewed from recent studies with heavy ion reactions in heavy nuclei, and some interesting problems for the interaction radius, etc., are pointed out. (auth)

34948 (JAERI-M-5567, pp 267-283) NUCLEAR CHEMISTRY OF HEAVY NUCLIDES. Baba, H. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Nuclear chemistry studied using heavy ion reactions are reviewed. The content consists of the fission studies (part I) and syntheses of known and new nuclides (part II). (auth)

34949 (JAERI-M–5567, pp 354-359) ON THE PRODUCTION OF NEW RADIO-ISOTOPES BY HEAVY-ION BOMBARDMENT. Hashizume, A.; Tendow, Y.; Katou, T.; Kumagai, H. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

The possibility of the production of new neutron-deficient radioisotopes by heavy ion reactions is briefly discussed. After a short comment on the new isotopes confirmed by our laboratory, techniques to measure the half-life in the millisecond region by a mechanical beam chopper are explained. The existence of new isomer in ^{204}At with $T_{\frac{1}{2}}$ = 9.7 ms produced by the ^{197}Au(^{12}C, 5n)^{204}At reaction is tentatively proposed. (auth)

34950 (ORO-4028-0021, pp 57-60) FRAGMENT ANGULAR DISTRIBUTIONS FROM FISSION OF ^{238}U, ^{209}Bi, and ^{197}Au by 140-MeV ^{4}He IONS. Clark, R. G.; Meyer, W. G.; Minor, M. M.; Roche, C. T.; Viola, V. E. Jr. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34951 (ORO-4028-0021, pp 61-64) MASS AND TOTAL KINETIC ENERGY DISTRIBUTION OF FRAGMENTS FROM 140-MeV ^{4}He-ION-INDUCED FISSION. Frick, E. W.; Viola, V. E. Jr. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34952 (ORO-4028-0021, pp 69-74) STUDIES OF STRONGLY DAMPED COLLISIONS IN REACTIONS BETWEEN 600-MeV ^{84}Kr IONS AND ^{209}Bi. Viola, V. E. Jr.; Wolf, K. L.; Unik, J. P.; Huizenga, J. R.; Birkelund, J.; Freiseleber, H. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34953 (ORO-4028-0021, pp 75-79) CROSS SECTIONS FOR COMPOSITE NUCLEUS FORMATION IN REACTIONS OF ^{40}Ar AND ^{84}Kr IONS WITH HEAVY NUCLEI. Viola, V. E. Jr.; Huizenga, J. R.; Birkelund, J.; Freiesleber, H.; Wolf, K. L.; Unik, J. P. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34954 DIFFERENTIAL CROSS SECTIONS OF INELASTIC INTERACTIONS OF NEUTRONS WITH NUCLEI Zn, Mo, Cd, In, Sn, Ta, Pb, AND NUCLEAR TEMPERATURES FOR THESE NUCLEI. Sal'nikov, O. A.; Anufrienko, V. B.; Devkin, B. V.; Kotel'nikova, G. V.; Kolpachev, A. G.; Lovchikova, G. N.; Fetisov, N. I.; Trufanov, A. M. Yadern. Fiz.; 20: No. 5, 852-856(Nov 1974). (In Russian).

Differential cross sections of the neutron inelastic interactions are presented for Zn, Mo, Cd, In, Sn, Ta, and Pb at the primary neutron energy of 14.4 MeV. The measurements are carried out in the cylindrical geometry by means of the time-of-flight method. The neutron inelastic cross sections are presented for the scattering angles of 61, 91, 121 and 151°. Values of the nuclear temperatures and of the nuclear level density parameters are obtained. (auth)

34955 EVIDENCE FOR α-PARTICLE STRUCTURE IN MEDIUM-HEAVY NUCLEI FROM OPTICAL ISOTOPE SHIFTS. Kuhn, H. G. (Oxford Univ.); Baird, P. E. G.; Brimicombe, M. W. S. M.; Stacey, D. N.; Stacey, V. Proc. Roy. Soc. (London), Ser. A; 342: No. 1628, 51-54(25 Feb 1975).

It is pointed out that optical isotope shifts between even-even isotopes in the medium-heavy elements show variations which are similar from one element to another, and that these variations are associated with particular values of N–Z, where N and Z refer to neutron and proton numbers respectively. Since the isotope shifts depend on differences in the mean square radii of the nuclear charge distribution, this correlation is evidence for some degree of α-particle structure in these nuclei. Further evidence

from the energies of the first excited levels of the nuclei is also briefly considered. (auth)

34956 MEASUREMENTS ON THE DECAY OF ^{202}Bi. Goering, S.; Hanser, A. (Kernforschungszentrum Karlsruhe (F. R. Germany). Zyklotronlaboratorium). Z. Phys.; 271: No. 2, 183-193 (Dec 1974). (In German).

An experimental investigation of the complex γ- decay of ^{202}Pb following the β-decay of ^{202}Bi is presented. Gamma-ray energies and intensities, conversion coefficients and γ-γ-coincidences were measured using mass separated sources. The results supplement and refine previous studies. In particular the measurements of gamma-ray energies aimed at an accuracy as high as possible in order to get reliable energy relations for the ordering of the γ-transitions in a level scheme. More than 200 γ-transitions were observed. New excited levels of ^{202}Pb are proposed at 2,185.0, 2,235.4, 2,324.9, 2,360.4, 2,517.3, 2,916.5, 3,682.2, and 3,723.5 keV above the ground state. The spin value I = 4 for the 1,915.1 keV level of ^{202}Pb is confirmed and to the 2,289.2 keV level the spin parity assignment $(6)^-$ is given. (auth)

34957 BETA-STRENGTH FUNCTIONS OF NEUTRON-DEFICIENT ISOTOPES IN THE XENON AND MERCURY REGIONS. Hornshoej, P. (Aarhus Univ. (Denmark)); Erdal, B. R.; Hansen, P. G.; Jonson, B. (European Organization for Nuclear Research, Geneva (Switzerland)); Aleklett, K.; Nyman, G. (Chalmers Tekniska Hoegskola, Goeteborg (Sweden). Institutionen foer Fysik). Nucl. Phys., A; 239: No. 1, 15-28(17 Feb 1975).

Beta-strength functions have been derived from measurements of EC β-feed to high-lying excited states of neutron-deficient isotopes of Hg, Au, Pt, Ir, Xe, and I. The activity was produced at the ISOLDE on-line facility at CERN and the β-feed was determined from γ-spectra measured with a total-absorption spectrometer. In one case, ^{113}Xe, the β-feed was extracted from the β-delayed proton spectrum. An increase of the strength towards lighter masses, as has been observed earlier for the average strength, is demonstrated especially for Hg and Au, where for both elements eight strength functions have been measured. In the xenon region shell-model calculations including pairing corrections give rates that exceed the experimental ones by factors of 2-5. (auth)

34958 DEPENDENCE OF THE COLLECTIVE NEUTRON CAPTURE CROSS SECTION ON SEVERAL PARAMETERS. Sakurada, K.; Kitazawa, H.; Yamamuro, N. (Tokyo Inst. of Tech. (Japan)). Bull. Tokyo Inst. Technol. (Engl. Ed.); No. 121, 1-9(Mar 1974).

The dependence of the collective capture cross section and γ-ray spectrum on the parameters V, W, $V_{so,vl}$, E and Γ is investigated. As a result, the capture cross section is quite sensitive to the parameters V, W and vl, and a careful choice of these parameters is required. (auth)

34959 TRIPLE COINCIDENCE STUDY OF THE PARTICLE SPECTRUM ASSOCIATED WITH K-SHELL ELECTRON SHAKE-OFF IN THE DECAY OF ^{204}Tl. May, J. T. Raleigh, NC; North Carolina State Univ. (1974). 92p. University Microfilms Order No. 75-7708.

Thesis (Ph. D.).

The coincident spectra of beta particles and orbital electrons ejected in the shake-off process were studied by acquiring the spectra of two plastic scintillation electron spectrometers in the dual parameter mode. Requiring the additional coincidence of the K-shell x-ray restricts the particle spectra to those associated with K-shell electron shake-off. The data were analyzed by summing columns in the dual parameter matrix array, applying the detector response function, and comparing the resulting spectrum with theory. The lowest energy row was then deleted, and this process was carried out again. The effect of deleting the lowest row is to raise the threshold for the lowest energy electron detected in coincidence with the corresponding summed spectrum. Six spectra were generated in this manner covering thresholds from 50 to 125 keV. Above 300 keV, theory and experiment agreed within experimental error. Below this energy, the magnitude of the experimental spectra was smaller than that predicted by theory. This result is attributed to electron-electron interactions enhanced by detector geometry and to the failure of the theory when at least one of the electrons does not have energy greater than about three times the K-shell binding energy. (Diss. Abstr. Int., B)

34960 LEAD NUCLEUS DISINTEGRATIONS BY 9 GeV PROTONS. Ciok, P. (Inst. of Nuclear Research, Warsaw); Sieminska, J.; Wisniewska, J. Acta Phys. Pol.; B6: No. 1, 113-121(1975).

The interactions of 9 GeV protons with lead nuclei have been investigated using stacks of nuclear emulsions interlayed with lead foils. The obtained experimental data about the number, nature, and energy of product nuclei have been analysed using the cascade-evaporation model and the radiochemical data for comparison. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 33343, 34778, 34950, 34951, and 34991.

34961 (DP-MS-74-61) CONSISTENT SET OF TRANSPLUTONIUM MULTIGROUP CROSS SECTIONS. Benjamin, R. W.; Vandervelde, V. D.; Gorrell, T. C.; McCrosson, F. J. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. 6p. (CONF-750303-7). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

A consistent set of multigroup neutron cross sections was developed for nuclides in the chain from ^{242}Pu to ^{253}Es. Evaluated multigroup cross section data were combined with experimental test measurements and production yields from long-term reactor irradiations in flux spectra of varying hardness; thus, 37- and 84-group data were derived, in part from ENDF/B and existing Savannah River Laboratory evaluated libraries. Where differential data were lacking, resonance-region model calculations and integral cross section values were combined to form the multigroup data. The data were tested with the JOSHUA system to calculate the reactor environment as a function of time and to predict the concentration of actinide nuclides in the chain. Cross section data were modified within experimental uncertainties until predicted nuclide concentrations matched experimental results within reasonable limits over the range of neutron flux spectra. (2 figures, 3 tables) (auth)

34962 (DP-MS-74-62) NUCLEAR DATA FOR ACTINIDE RECYCLE. Hennelly, E. J. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. 5p. (CONF-750303-19). Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Large quantities of heavy actinides will be byproducts of burning plutonium and uranium fuel in nuclear power reactors. Chemical recovery and subsequent recycle in reactors will be for the production of ^{238}Pu and ^{244}Cm as heat sources and ^{252}Cf as a unique source of neutrons or for the ultimate conversion of heavy actinides to shorter-lived fission products to reduce long-term waste storage problems. Test measurements and production yields have provided data for developing a consistent set of multigroup cross sections which give excellent predictions of actinide concentrations in a variety of reactor environments and exposures. These multigroup cross sections are compatible with advanced reactor theory calculational codes. (4 figures, 2 tables) (auth)

34963 (JAERI-M-5567, pp 300-305) STABILITY OF SUPERHEAVY NUCLEI. Yamada, M.; Uno, M.; Tominaga, T. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Stability of superheavy nuclei is investigated by the use of a new mass formula and a phenomenological theory of spontaneous fission. The fission half-lives of 114 and 110 are estimated to be roughly a year and an hour, respectively, though these values are susceptible to various uncertainties. (auth)

34964 (JAERI-M-5567, pp 306-311) CALCULATED PRODUCTION CROSS SECTION OF SUPERHEAVY NUCLEI. Imanishi, N.; Nishi, T.; Fujiwara, I. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

The production cross section of superheavy nuclei (SHN) through the compound process is calculated, and the most probable combinations of projectiles and targets are presented. In the calculation of the complete fusion cross section, the Coulomb barrier and a critical angular momentum are taken carefully into account, and it is found that the complete fusion cross section is some orders of magnitude less than the total cross section deduced from the usual semi-classical sharp-cut-off model. A simple spin-dependent competition is introduced in the de-excitation process of a compound nucleus, and the overall production cross sections are obtained. (auth)

34965 (ORO-4028-0021, pp 53-56) LINEAR MOMENTUM TRANSFER IN REACTIONS BETWEEN 140-MeV ^{4}He IONS AND HEAVY NUCLEI. Viola, V. E. Jr.; Roche, C. T.; Meyer, W. G.; Clark, R. G. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34966 (ORO-4028-0021, pp 65-67) FISSION FRAGMENT ANGULAR DISTRIBUTION AND CROSS-SECTION STUDIES. Meyer, W. G.; Clark, R. G.; Viola, V. E. Jr.; Theus, R. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34967 (ORO-4028-0021, pp 80-83) COMPLETE FUSION CROSS SECTIONS FOR THE ^{20}Ne + ^{235}U SYSTEM. Zebelman, A. M.; Viola, V. E. Jr.; Sextro, R.; Meyer, W. G.; Clark, R. G. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34968 INCONSISTENCY OF TWO-CENTER SHELL MODELS. Morozov, D. F. (Novosibirsk Div. of Specialized Assembly–Alignment Control, USSR). Yadern. Fiz.; 20: No. 5, 857-861 (Nov 1974). (In Russian).

Sizes and shapes of fragments are calculated using the wave functions of a two-center oscillator for two cases: a symmetrical fission of the ^{238}U nucleus into two spherical fragments, the asymmetrical fission with production of two spheroids. Dependence of the oscillator frequencies on the deformation parameter is determined from the condition of conservation of volume in average inside every equipotential. The calculated and the liquid-drop nuclear sizes and shapes are different. To improve consistency of the two-center models it is proposed to construct the potentials in such a way as to provide the equipotentials with a more oblong shape than that of the liquid drop. (auth)

34969 EFFECTIVE INTERACTION OF HEAVY IONS, FISSION OF NUCLEI AND CHANNEL EFFECT IN THE REACTIONS OF FULL FUSION. Delchev, Ya.; Petkov, I. pp vp of Second National Conference of the Young Physicists. Sofia; Komitet za Mirno Izpolzuvane na Atomnata Energiya (1974). (In Bulgarian).

From 2nd national conference of the young physicists; Sofia, Bulgaria (10 Apr 1974).

A method for construction of the effective interaction between heavy ions in the sudden knock approach is proposed. For a distance between the two nuclei $R > R_c$ the effective interaction is of a Coulomb type, and for $R \leq R_c$ it depends linearly on the mass in the region of the overlapping of the two nuclei. If the total density is greater than 0.17 fermi^{-3} the effective interaction of nuclei with mass number $A = A_1 + A_2$ is considered as a potential wall. The height of the wall is of the order of the maximal kinetic energy, which would be emitted in the fission of a nuclei with mass number $A = A_1 + A_2$. The dependence of the well depth, of the barrier height and of the steepness of the effective interaction in the inner (with respect to the barrier) region of the ratio A_1/A_2 is studied. The effective interaction depends essentially on the surface structure of the two nuclei. A maximal barrier is obtained for $A_1 = A_2$. The effective interaction is used for the calculation of the lifetime of spontaneously fissile nuclei (symmetrical and asymmetrical). (INIS)

34970 RELATION BETWEEN ENERGIES AND PERIODS OF SPONTANEOUS FISSION. Kolesnikov, N. N.; Soshinskii, S. A. (Uzhgorod State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 7-10(1974). (In Russian).

An attempt was made to establish a relation between energies and periods of the spontaneous fission of even-even nuclei. Spontaneous fission is a tunneling effect. Therefore from general considerations it can be expected that the periods of spontaneous fission would show, in analogy to α decay, a tendency to increase with increase of the charge of the nucleus Z and with decrease of the energy of spontaneous fission E_f and would depend also on the mass number A. Actually under stable equal conditions the increase of Z leads to an increase and broadening of the barrier and increase of E_f leads to a decrease of the barrier penetration. The increase of A, on the one hand, increases the reduced mass of the fragments inhibiting their passage through the barrier and, on the other hand, leads to an increase of the dimensions of the fragments which reduces the barrier height. With respect to the effects of the shells and subshells on the size of E_f, it is possible to some degree to take into consideration their effects on the periods of spontaneous fission. A combination method was used to calculate E_f. In the first place precise experimental values of the mass of the nucleus and the transition energy were used; if these were lacking formulas for the energy of the nuclear transitions were used which were based on a detailed systematic analysis of experimental data. (tr-auth)

34971 NEUTRON CROSS SECTION OF ^{238}U IN THE ENERGY RANGE BETWEEN 1 KeV AND 20 MeV. Kanda, Y. (Kyushu Univ., Fukuoka (Japan)). pp 10-17 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese).

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

Evaluation of the neutron cross section of ^{238}U was performed for the energy range between 1 keV and 20 MeV. Collected data were often inconsistent with each other probably because of systematic error. The investigation of each data set was performed. It was impossible to obtain all partial cross sections (σ_i). Reliable experimental data on measured cross sections were able to be selected only regarding that of total (σ_t), radiative (σ_r) and fission (σ_f). The purpose of the present study is to obtain a set of cross sections that satisfies relation $\sigma_t = \Sigma_i \sigma_i$. The considered partial cross sections were σ_r, σ_f, σ_n, $\sigma_{n'}$, σ_{2n} and σ_{3n}. The cross sections of (n,p) and (n,α) reactions were small, and were not taken into consideration. The accepted data of σ_t were measurement by Kopsch for the energy range 0.5–4.5 MeV, by Foster for 4.5–15 MeV, and by Bratenabl and Peterson for more than 15 MeV. Data by Fricke, Poenitz and Nagle were accepted as the reliable data of σ_r. Data by Hansen normalized with data by Stein were used for the cross section σ_f. The other cross sections were properly estimated by using incomplete sets of measured values. Evaluated values of σ_t, σ_r, σ_f, σ_n, $\sigma_{n'}$, σ_{2n}, and σ_{3n} are shown in a table. The values of σ_n and $\sigma_{n'}$ have strong correlations with other, and accuracy of absolute values was not so good. The values of σ_t are relatively large, consequently the absolute values of error are large, which depends largely on the estimation of small cross section. (JA)

34972 REVISION OF JAERI-FAST SET BASED ON BENCH MARK TEST. Takano, H.; Hasegawa, A.; Katsuragi, S. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). pp 68-76 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese).

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

Taking up the main nuclear cross section of important nuclides from the nuclear data which forms the foundation of JAERI-FAST Set, the estimated values of integral quantities were inspected by benchmark test. The effect of the uncertainty of nuclear data on the integral quantities was investigated on each fission cross section (σ_f) and capture cross section (σ_c) of U-235, U-238 and Pu-239. As for analytical codes, EXPANDA-70D—one dimensional critical diffusion calculation code—and XPRTC—integral quantity calculation code—were utilized. The effect of each cross section on the integral quantities was investigated when the values of σ_f and σ_c of U-235, U-238 and Pu-239 were increased by 10% in the energy region of 1 keV to 10.5 MeV. To the criticality, σ_f(Pu-239) and σ_f(U-235) contribute by about 5% respectively, and σ_f(U-238) 0.5–1.5%. As for the capture cross section, both σ_c(U-235) and σ_c(Pu-239) contribute by only 0.5%, but σ_c(U-238) contributes relatively large. The modification of the cross section of three important nuclides was performed by the method of least squares. As a result, the gradient of an effective multiplication factor (k_{eff}) to enrichment ratio was eliminated, and adequate values of the cross section were determined within the uncertainty of nuclear data. (JA)

34973 CALORIMETRIC MEASUREMENT OF RADIOACTIVE ISOTOPE HALF-LIVES. Chapter 5. Shimanskaya, N. S. pp 131-148 of Ionizing Radiation Calorimetry. Moscow; Atomizdat (1973). (In Russian).

This chapter considers the use of the calorimetric method for determining the half-life of radioisotopes. Data are presented on more than 30 calorimetric determinations of the half-lives of various isotopes. Methods of the calorimetric measurement of the half-life of long-lived isotopes, in particular, plutonium-239, uranium-232, americium-241 and actinium-227 are considered. (INIS)

34974 CONTEMPORARY CONCEPTS ON THE POSSIBILITY FOR THE FORMATION OF SUPERHEAVY ELEMENTS IN NATURE. Berlovich, E. E. (Leningrad Inst. of Nuclear Physics). Izv. Akad. Nauk SSSR, Ser. Fiz.; 38: No. 9, 1786-1790(Sep 1974). (In Russian).

Possible mechanisms for the nucleosynthesis of superheavy elements in nature are examined. From mechanisms at the stellar level, r-processes during the explosions of supernovae, reactions with heavy ions during explosions of supernovae, and processes in neutron stars were discussed. Contemporary astrophysical data indicate that in addition to the stellar mechanisms the formation of heavy elements is possible in some galactic mechanisms in early stages of the galactic evolution. (tr-auth)

34975 EXPERIMENTS ON THE SYNTHESIS OF NEUTRON-DEFICIENT KURCHATOVIUM ISOTOPES IN REACTIONS INDUCED BY ^{50}Ti IONS. Oganessian, Yu. Ts.; Demin, A. G.; Iljinov A. S.; Tretyakova, S. P.; Pleve, A. A.; Penionzhkevich, Yu. E.; Ivanov, M. P.; Tretyakov, Yu. P. (Joint Inst. for Nuclear Research, Dubna (USSR)). Nucl. Phys., A; 239: No. 1, 157-171 (17 Feb 1975).

By bombarding Pb isotopes with ^{50}Ti ions, two new isotopes of element 104 (kurchatovium) with mass numbers 255 and 256 have been synthesized. The isotope ^{256}Ku has been formed in the reaction ^{208}Pb(^{50}Ti,2n), and has a spontaneous fission half-life of about 3 msec. The odd isotope ^{255}Ku has been formed with a maximum cross section in the reaction ^{207}Pb(^{50}Ti,2n), and has a half-life of several seconds. The experimental results obtained, together with the available data on the properties of kurchatovium, substantially change the understanding of the stability of heavy nuclei with respect to spontaneous fission. In this connection the influence of the structure of the fission barrier on the properties of heavy nuclei is discussed. On the basis of the experimental data on the synthesis of Fm and Ku neutron-deficient isotopes in reactions induced by ions heavier than argon, the possibilities of synthesizing elements with $Z \geq 106$ are investigated. (auth)

34976 HIGH-RESOLUTION α-SPECTROSCOPY OF ^{253}Es AND ^{255}Fm. Ahmad, I.; Milsted, J. (Argonne National Lab., Ill. (USA)). Nucl. Phys., A; 239: No. 1, 1-14(17 Feb 1975).

Alpha-particle spectra of ^{253}Es and ^{255}Fm have been measured with a high-resolution magnetic α-spectrometer. Isotopically enriched samples prepared in the Argonne electromagnetic isotope separator were used for these measurements. Precise energies and intensities of ^{253}Es and ^{255}Fm α groups have been determined. Two new α groups have been identified in the decay of ^{255}Fm. The relative intensities of α groups populating members of unfavored bands are found to be in good agreement with the theoretical values. For the favored bands the theoretical calculations cannot reproduce the experimental intensities. The enhancement in the intensities of α groups feeding the $5/2^+$ [642] band in ^{249}Bk has been quantitatively explained by a Coriolis interaction calculation. (auth)

34977 ALTERNATIVE REGIONS OF METASTABLE HEAVY AND SUPERHEAVY ELEMENTS DIRECTLY ACCESSIBLE IN HEAVY-ION REACTIONS. Bengtsson, R.; Larsson, S. E.; Nilsson, S. G. (Tekniska Hoegskolan, Lund (Sweden). Institutionen foer Matematisk Fysik); Ragnarsson, I. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Phys. Lett., B; 55: No. 1, 6-10(20 Jan 1975).

In this letter, quasi-stable superheavy nuclei on the neutron-deficient side of the beta-stability line are investigated using the macroscopic–microscopic method developed by Strutinsky. Its ingredients are a liquid-drop macroscopic-energy term and a shell-energy term, obtained from the modified-oscillator model. (NL)

34978 MEASUREMENTS ON DELAYED NUETRON SPECTRUM OF THE SECOND GROUP ($T_{\frac{1}{2}}$ = 22 sec) FROM PHOTOFISSION OF ^{238}U. II. Iwasaki, S.; Yana, K.; Sato, S.; Sano, K.; Hagiwara, M. (Tohoku Univ., Sendai (Japan). Faculty of Engineering). Kakuriken Kenkyu Hokoku; 7: No. 1, 88-90(Jun 1974). (In Japanese).

Measurements on delayed neutron spectrum of the second group ($T_{\frac{1}{2}}$ = 22 sec) from photofission of ^{238}U were performed using time of flight technique between beta particles and neutrons. Experimental results showed fine structure in the neutron energy spectrum. The six peaks were observed in the spectrum; 200 keV, 240 keV, 280 keV, 380 keV, 540 keV and ~750 keV. These were considered to correspond with the peaks reported by S. Shalev and J. Cuttler except for the two peaks, 200 keV and 280 keV. (auth)

34979 APPLICATION OF THE RANK ANNIHILATION METHOD IN THE R MATRIX THEORY. Mihailescu, I. M. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 19: No. 10, 1065-1075(1974).

The collision matrix expression in terms of the R-matrix is adequate for the application of the rank annihilation method. Generalizing the Reich-Moore method to an arbitrary number of fission channels and using the rank annihilation method in getting the channel matrix elements, the most general formula of the neutron fission cross section, applicable to N interfering resonance levels and without referring to the number of open fission channels, is obtained. The ^{238}U fission cross-section values computed by this method for neutron energies less than 2 eV are compared with those previously obtained by the Voigt method. A good fit to the experimental data is found. (auth)

34980 FURTHER CALCULATIONS, BEING AN ADDENDUM TO THE PAPER CALCULATIONS RELATIVE TO THE EXPERIMENTAL OBSERVATION OF THE PRODUCTS OF DISINTEGRATION OF ^{5}He LIBERATED AS A LIGHT PARTICLE IN TERNARY FISSION. Feather, N.; Vass, D. G. (Univ. of Edinburgh, Eng.). Proc. Roy. Soc. Edinburgh, Sect. A; 71: 293-296(1974).

The analysis of the previous paper (Feather and Vass, Proc. Roy. Soc. Edin.; 71A: 233-248 (1973)) is extended, taking account of the spread of Q-values in the disintegration $^{5}\text{He} \rightarrow {}^{4}\text{He} + {}^{1}\text{n}$. Conclusions in respect of the experimental results of Cheifetz et al. (Phys. Rev. Lett.; 29: 805-808 (1972)) remain essentially unchanged. (auth)

34981 ESTIMATIONS OF HALF-LIVES OF FAR-SUPERHEAVY NUCLEI WITH Z APPROX. = 154–164. Lukasiak, A.; Sobiczewski, A. (Inst. for Nuclear Research, Warsaw). Acta Phys. Pol.; B6: No. 1, 147-165(1975).

The spontaneous fission and alpha-decay half-lives of doubly-even superheavy nuclei with $Z \approx 154-164$ are calculated microscopically. The beta stability is also investigated. The longest total half-lives of the order of $10^{5}-10^{7}$ years are obtained for nuclei in the neighborhood of doubly magic nucleus ^{472}(164). (auth)

Nuclear Theory

Refer also to abstracts 34629, 34723, 34912, 34946, and 35122.

34982 (ANCR-1200, pp 21-24) INCLUSION OF THE EFFECTS OF HEXADECAPOLE DISTORTION ON CORIOLIS MIXING AND GAMMA-RAY TRANSITION PROBABILITIES IN DEFORMED NUCLEI. Reich, C. W. Jan 1975.

In nuclear structure studies utilizing LAMPF.

34983 (ANL/HEP-75-02, pp XXII.1-XXII.12) SPIN IN LOW ENERGY PHYSICS (THEORY). Gammel, J. L. (St. Louis Univ.). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

Two topics are discussed that typify some of the work going on at present in low energy nuclear physics. The first of these is the effort to detect the effect of the nuclear spin in proton-heavy nucleus scattering, and the second is the importance of quadratic relations among observables measured in polarization experiments. (LBS)

34984 (ANL/HEP-75-02, pp XXIV.1-XXIV.35) THEORETICAL INTERPRETATION OF EXPERIMENTS WITH POLARIZED PROTON BEAMS. Halzen, F. (Univ. of Wisconsin, Madison). 1974.

In proceedings of the summer study on high-energy physics with polarized beams, Argonne, Illinois, July 22–26, 1974.

The simplicity and transparency of the language of optics is stressed in discussing experiments with polarized beams and/or polarized targets. The assumption that spinning nucleons only interact through a spin-orbit force, supplemented with general knowledge about the impact parameter structure of the proton yields a one parameter model for all polarization parameters consistent with the available data. The relation between the s-channel optical language and the t-channel exchange language is discussed. Possible applications to purely peripheral reactions are also proposed. (auth)

34985 (ANU-P-601) PROGRAM FOR CALCULATION OF GAMMA-RAY ANGULAR DISTRIBUTIONS FOLLOWING STATISTICAL COMPOUND NUCLEUS REACTIONS (SUPERSEDES SECTIONS OF ANU-P-584). Kean, D. C. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Sep 1974. 8p. Dep. NTIS (US Sales Only) $4.00.

HAWSER is a computer program which calculates gamma-ray angular distributions. A revised version of HAWSER, called MANANU, is now available. This program calculates population parameters correctly and uses the Rose and Brink sign convention for mixing ratios (due to a programming error, HAWSER uses the opposite convention). In addition, the new version requires less input data, and has a more convenient output format. (AT)

34986 (CEA-CONF-2891) INFLUENCE OF A CRITICAL ANGULAR MOMENTUM ON ANGULAR DISTRIBUTIONS OF SPIN-ZERO PARTICLE REACTIONS. da Silveira, E. F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Basse Energie; Pontificia Universidade Catolica do Rio de Janeiro (Brazil)). [nd]. 9p. (CONF-740747-1). Dep. NTIS (US Sales Only) $4.00.

From course on nuclear spectroscopy and nuclear reactions with heavy ions; Varenne, Italy (22 Jul 1974).

One method for studying the angular momentum upper limit at a given compound-nucleus excitation energy is the analysis of

angular distribution shapes. When both incoming and outgoing particles have zero spins, angular distributions show strongly oscillating patterns which are characteristic of high-spin states in the intermediate compound nucleus. The method is illustrated with reference to the reaction $^{12}C(^{12}C,\alpha)^{20}Ne_{g.s.}$. (4 figures, 1 table) (RWR)

34987 (CONF-750303-14) DEVELOPMENT OF A TWO-STEP HAUSER-FESHBACH CODE WITH PRECOMPOUND DECAYS AND GAMMA-RAY CASCADES: A THEORETICAL TOOL FOR CROSS SECTION EVALUATIONS. Fu, C. Y. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 4p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

The code is used to calculate neutron-induced binary reaction, tertiary reaction, and associated gamma-ray-production cross sections of ^{19}F, ^{40}Ca and ^{56}Fe. Comparisons with experimental data show much improved agreements over those previously possible. (3 figures) (auth)

34988 (COO-2171-42) E2 POLYNOMIAL STRENGTHS: A COMPARISON WITH SHELL-MODEL RESULTS. Draayer, J. P.; French, J. B.; Potbhare, V.; Wong, S. S. M. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy; Toronto Univ., Ontario (Canada). Dept. of Physics). [nd]. 10p. Dep. NTIS $4.00.

Polynomial-expansion E2 strengths and sum rules involving $(J,T) = (0,0)$ and $(2,0)$ states of $(ds)^6$ are compared with shell-model results. The agreement is excellent. The strength distribution is describable as a narrow linear ridge in the energy space. The level-to-level fluctuations in the total strength are small, as expected from a theorem of Dyson and Mehta; fluctuations in the first and second moments are also small. The effect of collectivity and the partitioning of the sum rules into exothermic and endothermic parts are discussed. (2 figures) (auth)

34989 (COO-3069-279) FIELD THEORY METHODS FOR FINITE NUCLEAR SYSTEMS AND THE POSSIBILITY OF DENSITY ISOMERISM. Kerman, A. K.; Miller, L. D. (Massachusetts Inst. of Tech., Cambridge (USA)). 1974. Contract AT(11-1)-3069. 18p. (CONF-740740-1). Dep. NTIS $4.00.

From 2nd high energy heavy ion summer study, Berkeley, California (15 Jul 1974).

A derivation of the relativistic Hartree equations for infinite or finite systems is first presented. Then the Hartree approximation of the σ-model field theory is solved exactly for the case of infinite nuclear matter and the results are compared to the approximate results of Lee and Wick. This comparison leads to the conclusion that the nonlinearities of the σ-model are important not only for nuclear matter in the density region corresponding to the abnormal state but also in the region corresponding to normal nuclear densities. The equations appropriate for an iterative solution of the Hartree approximation of a finite system are also presented. Attempts to solve these equations have so far met with instabilities in the iterative procedure. These instabilities are discussed and speculations are made regarding the possible properties of the final converged solutions of the Hartree approximation to finite systems. (LBS)

34990 (INS-TCH-10) COMPD: A COMPUTER PROGRAM FOR THE CALCULATION OF THE EXCITATION FUNCTIONS BY MEANS OF MONTE CARLO METHOD. Komura, K.; Tanaka, S. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 29 Aug 1974. 25p. (In Japanese). INIS.

A computer program has been developed for the calculation of excitation functions by the statistical theory based on the Compound Nucleus Model. The fundamental techniques of the calculation are based on the Monte Carlo method developed by Dostrovsky et al. The program can treat neutrons, protons, deuterons, tritons, helium-3 and alpha particles as the incident and/or the outgoing particles. The core size required for the calculation is about 11 K words, and the calculating time on the TOSBAC 3400/M51 machine is 30 minutes to follow 14000 cycles of evaporation cascade. (auth)

34991 (JAERI-M-5567, pp 293-299) POTENTIAL ENERGY SURFACE OF NUCLEAR FISSION. Suekane, S.; Yamaji, S.; Iwamoto, A.; Harada, K. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

The present status of the study of the potential energy surface for nuclear fission is discussed critically. The total potential energy has been calculated for the symmetric and the asymmetric fissions of ^{236}U based on the modified two-center oscillator potential, and the results are discussed. (auth)

34992 (JAERI-M-5567, pp 350-353) AN EVALUATION FOR THE (HI,xn) REACTION CROSS SECTION. Kotajima, K.; Takeda, Y.; Shinozuka, T.; Takekoshi, E. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

An expedient computer program based on statistical model considerations has been coded and examined for evaluating the (HI,xn) reaction cross section. (auth)

34993 (ORO-4028-0021, pp 32-45) DEVELOPMENT OF A PHENOMENOLOGICAL DESCRIPTION OF TRANSITIONAL ODD-MASS NUCLEI. Mathews, G. J.; Immele, J. D. 1 Nov 1974.

In research in nuclear chemistry. Annual progress report.

34994 CONSTRUCTION OF THE NUCLEAR-MATTER POTENTIAL THROUGH INFORMATION OBTAINED FROM ITS GROUND STATE. Minelli, T. A. (Univ., Padua). Lett. Nuovo Cim.; 12: No. 11, 391-394(15 Mar 1975).

The Hugenholtz and Van Hove relation and the momentum dependence of the potential are used for the construction of the nucleon-nucleus potential by using information obtained from the ground state of nuclear matter. (JFP)

34995 FERMION HYPERNETTED CHAIN AND THE PERCUS-YEVICK APPROXIMATIONS. Campani, E.; Fantoni, S.; Rosati, S. (Univ., Pisa, Italy). Lett. Nuovo Cim.; 12: No. 11, 395-398(15 Mar 1975).

The results of some numerical calculations on symmetrical nuclear matter are presented based on two different approximations. The two-body distribution function and the binding energy per particle in nuclear matter are calculated. (JFP)

34996 DETERMINATION OF PARAMETERS OF NEAR-THRESHOLD RESONANCES BY MEANS OF FEYNMAN GRAPHS. Dubovoi, E. I. Yadern. Fiz.; 20: No. 5, 900-910(Nov 1974). (In Russian).

Irregularities in differential cross sections as functions of the incident energy, due to the contribution to the nuclear reaction amplitude from Feynman graphs with two-particle intermediate states and virtual excited nuclei, are investigated. It is shown that these graphs result in the presence of a pole singularity in the reaction amplitude near the threshold of the opening channel, that is observed as a resonance in the reaction cross section. The position and width of the resonance are calculated as well as the reduced decay widths determining the particle scattering lengths on excited nuclei. (auth)

34997 DYNAMICAL CORRECTIONS FOR THE ELASTIC AND INELASTIC SCATTERING OF ELECTRONS ON NUCLEI. Garistov, V. pp vp of Second National Conference of the Young Physicists. Sofia; Komitet za Mirno Izpolzuvane na Atomnata Energiya (1974). (In Bulgarian).

From 2nd national conference of the young physicists; Sofia, Bulgaria (10 Apr 1974).

The role of the nuclei dynamics in the elastic and inelastic scattering of electrons on nuclei is studied. When the virtual transitions are not taken into account the usual cross-section for the scattering of electrons on nuclei with a static distribution of the charge is obtained. The virtual transitions in the cross-section of elastic and inelastic scattering play an essential role only for high moments. To take these corrections into account one can equivalently consider the scattering of electrons on nuclei with a density corresponding to an axial deformed nuclei. (INIS)

34998 INFLUENCE OF TENSOR FORCES ON THE GLOBAL NUCLEAR CHARACTERISTICS. Gorbatov, A. M. (Kalinin State Univ., USSR). Yadern. Fiz.; 20: No. 5, 894-899(Nov 1974). (In Russian).

Using Green's functions a variational method is developed to calculate nuclear ground states. In particular, the method enables one to take into account noncentral forces vanishing at the calculation of the closed-shell nuclei in the leading approximation of the K-harmonics method. There are some situations when the leading K-harmonics approximation results in an absence of any bound state for a nucleus, while bound states exist in the presented variational approach. (auth)

34999 EXCLUSION OF OCCUPIED STATES FROM THE NUCLEAR OPTICAL AMPLITUDES AND POTENTIALS. Krasnopol'skii, V. M.; Kukulin, V. I. (Moscow State Univ.). Yadern. Fiz.; 20: No. 5, 883-893(Nov 1974). (In Russian).

Methods to exclude occupied states from the optical amplitudes and potentials are presented and investigated analytically. It is shown that the method, based on exclusion of the Weinberg quasi-

particles (Sturm's terms) corresponding to the occupied states, changes the initial phase shifts essentially, though resulting in a suppression of the contribution from occupied states. To avoid this difficulty a pseudopotential method of exclusion is proposed. It is shown that with a pseudo-Hamiltonian one gets scattering amplitudes with no singularities at negative energies corresponding to occupied states. The scattering theory for pseudo-Hamiltonians is formulated; it is shown that a pseudo-potential with an infinite coupling constant corresponds to a cut-off in the spectral expansion of Green's function. The stability of the present procedure is studied numerically. (auth)

35000 R-MATRIX DEVELOPMENT OF THE COUPLED-CHANNELS THEORY. Suzuki, T. (Shizuoka Univ. (Japan). Faculty of Science). Rep. Fac. Sci., Shizuoka Univ.; 8: 7-12 (Dec 1973).

The theoretical development on coupled-channel method by utilizing and emphasizing the quality of the R-matrix theory is presented. The employment of R-matrix technique will serve to efficiently evaluate transition amplitude by means of diagonalization procedure using a truncated space of functions with specified quantum number. The basic idea of this paper lies in that only the amplitudes for channels of particular importance are represented through the diagonalization in terms of a truncated space and resulting effective interaction, while the wave function obeying coupled equations is written by means of solution of a tractable model Hamiltonian. A boundary condition operator with boundary condition parameter b_c is introduced to construct the coupled-channels theory for the present purpose. With this operator, a Schrödinger equation is formulated. A wave function is obtained for the internal region of configuration space, and rewritten for the appropriate choice of a set of b_c. After channel elimination, the coupled-equation is obtained. By performing the diagonalization, the solution is obtained. Supplementary remarks on the formulation are described. (JA)

35001 INFLUENCE OF THE INTERACTION OF QUASI-PARTICLES WITH PHONONS ON THE STRUCTURE OF 2^+-STATES OF THE EVEN-EVEN SPHERICAL NUCLEI. Vdovin, A.; Stoyanov, Ch. pp vp of Second National Conference of the Young Physicists. Sofia; Komitet za Mirno Izpolzuvane na Atomnata Energiya (1974). (In Bulgarian).

From 2nd national conference of the young physicists; Sofia, Bulgaria (10 Apr 1974).

In the superfluid nuclei model formalism Vdovin, Kirchev and Stoyanov have obtained equations for the energy and the structure of the 2^+-state wave function, taking into account the interaction of the quasiparticles with the phonons. In the present paper on the basis of these results calculations of the energy and of some electromagnetic characteristics of two groups of nuclei near to Z = 50 and near to N = 82 are made. The admixtures of two-quasiparticles components in the structure of 2_1^+-states are well noticeable, and for the semimagic nuclei they prevail. In many cases the magnitude of the two-phonon component in the structure of these states is found to be underestimated, but for the isotopes of Te satisfactory results are obtained. (INIS)

35002 BASIC FUNCTIONS INVOLVED IN A SCHEMATIC TREATMENT OF SUBTHRESHOLD NUCLEAR FUSION. Steenkamp, P. J. (Ruprecht-Karl Universitaet, Heidelberg (F. R. Germany)). Tydskr. Natuurwetensk.; 14: No. 1, 5-19(Mar 1974).

The construction of a convenient set of basis functions to be used in a schematic approach to subthreshold fission is considered. Potentials suitable for the definition of appropriate class I and class II compound states as well as the fission channel are proposed. It is shown that the particular choice of potentials leads to direct fission being neglected, as well as to the assumption that the Hamiltonian can be taken as diagonal in the subspaces spanned by the neutron continuum and fission continuum. Some numerical results are presented as motivation for neglecting the non-orthogonality of the constructed basis. (INIS)

35003 HIGH ENERGY HADRON COLLISIONS ON COMPLEX NUCLEI AND PROPAGATION OF HADRONIC SYSTEMS THROUGH NUCLEAR MATTER. Van Hove, L. (CERN, Geneva). pp 371-383 of Particle Interactions at Very High Energies. Part A. Speiser, D. (ed.). New York; Plenum Publishing Corp. (1974).

From 2nd summer institute on particle interactions at very high energies; Louvain, Belgium (12 Aug 1973). See CONF-730863-PA.

Two experiments are briefly discussed which suggest that the study of high energy hadron collisions on complex nuclei may well become an important source of information on multiparticle hadrodynamics. Then some of the theoretical problems connected with the propagation of an excited hadronic system through nuclear matter are analyzed. The experiments are diffractive dissociation of pions on nuclei and general production processes on nuclei in an emulsion exposure in the 200-GeV proton beam. (JFP)

35004 ASYMMETRIC FISSION IN THE SHELL-CORRECTION METHOD WITH THE ASYMMETRIC TWO-CENTER SHELL MODEL. Slavov, B. (Sofia Univ. (Bulgaria). Fizicheski Fakultet); Faessler, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Z. Phys.; 271: No. 2, 161-167(Dec 1974).

The asymmetry of the fragment mass distribution of fissioning nuclei is described by suitable parametrization of an asymmetric two-center shell model (ATCSM). The deformation energy surface is calculated by applying a modified shell-correction prescription due to Strutinsky. It is shown that the ATCSM is specially suited for the description of the scission asymmetry which turns out to be strongly dependent on the shell structure of the fragments. It is demonstrated that the mass asymmetry at scission is unaffected by whether or not the Strutinsky renormalization for the shell corrections is employed for the calculation of the deformation energy surface. (auth)

35005 PION AND NUCLEAR CORRELATIONS. Ohta, K. (Tokyo Univ. (Japan). Coll. of General Education). J. Phys. Soc. Jap.; 36: No. 5, 1261-1265(May 1974).

Behavior of pions propagating in nuclear matter is investigated, the nucleus being described as a coupled system of nucleons and pions. Particular attention is paid to the particle-hole collective excitation. Based on the modified pion propagator, the pion-nucleus scattering and the effective internucleon potential are discussed. (auth)

35006 FORMULA FOR THE CALCULATION OF THE NUCLEAR SPIN COUPLING CONSTANT. Kloepper, D. (Karl Marx Univ., Leipzig). Acta Phys. Acad. Sci. Hung.; 37: No. 1-2, 171-173(1974).

An expression is given for the contact contribution to the nuclear spin coupling without introducing the formalism of the spin density. (JFP)

35007 SOME FEATURES OF THE COLLECTIVE WAVE-FUNCTION AND FRACTIONAL-PARENTAGE COEFFICIENTS OF THE INTERNAL NUCLEAR WAVE-FUNCTION. Vanagas, V. V.; Kalinauskas, R. K. Liet. Fiz. Rinkinys; 14: No. 4, 549-560(1974). (In Russian).

The explicit decomposition of the collective nuclear wave function in terms of the n-dimensional oscillator functions is given (n-number of the nucleons). The recurrent relations between one- and two-particle fractional-parentage coefficients of the internal nuclear wave function are obtained. Some transformational properties of the Jacobi polynomials, connected with the basis of the $O_{i_1}^+ \dotplus O_{i_2}^+$ subgroup of the orthogonal $O_{i_1+i_2}^+$ group are described. (auth)

35008 FINITE NUCLEI IN MANY BODY THEORY. Ulehla, I. (Charles Univ., Prague). Czech. J. Phys.; B24: No. 12, 1322-1337(1974).

An exact method of solution of the Goldstone equation for reaction matrix for finite nuclei is presented. The method can be applied to any double-magic nucleus if the two-nucleon potential does not contain a hard core. The basic properties of the nucleus, i.e., binding energy, nucleon densities, r.m.s. and form factor are expressed with the help of reaction matrix and certain auxiliary quantities and related to the center of mass motion. (auth)

35009 DOPPLER-BROADENED γ-RAY LINESHAPE ANALYSIS IN MULTIPLE COULOMB EXCITATION. Inamura, T.; Kearns, F.; Lisle, J. C. (Manchester Univ. (UK). Dept. of Physics). Nucl. Instrum. Methods; 123: No. 3, 529-539(1 Feb 1975).

A procedure is described for extracting nuclear lifetimes from the Doppler-broadened γ-ray lineshapes in multiple Coulomb excitation. It is shown that in the region of deformed nuclei the statistical tensors calculated using rotational matrix elements according to the Winther-de Boer multiple Coulomb excitation computer program give a lineshape practically independent of the values of the matrix elements used because the inelastic particle angular distribution remains virtually unchanged for variations of about 20% in the values of the matrix elements concerned. It is found that for high recoil velocities (up to 6,5% of the velocity of light) better fits to the experimental lineshapes are obtained using Northcliffe-Schilling electronic stopping power data coupled with Lindhart, Scharff and Schiott (LSS) theoretical nuclear stopping power, compared to those produced using LSS theoretical stopping powers only. The procedure used also takes into account the effects of multiple nuclear scattering, photon aberration, and the change in detection efficiency of Ge(Li) with the Doppler shift. Extracted lifetimes of several Coulomb excited

states are compared with those independently reported and are found to be in good agreement with them. (auth)

35010 SEMIEMPIRICAL ATOMIC MASS FORMULA. Seeger, P. A.; Howard, W. M. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Phys., A; 238: No. 3, 491-532(10 Feb 1975).

An atomic mass formula based on the liquid-drop model with shell and deformation energies determined from the Nilsson model and BCS pairing energy has been adjusted simultaneously to ground-state binding energies and to fission barrier heights. A short table of calculated values is included, and additional calculations are available. (auth)

35011 CALCULATION OF THE THRESHOLD FOR π^- CONDENSATION IN NEUTRON MATTER. Baeckman, S. O.; Weise, W. (State Univ. of New York, Stony Brook (USA). Dept. of Physics). Phys. Lett., B; 55: No. 1, 1-5(20 Jan 1975).

The threshold conditions for a phase transition to a negative pion condensate in neutron matter are studied. In the nucleon–nucleon particle–hole interaction it is essential to take into account the off-diagonality of the nucleon–nucleon interaction due to finite π^- meson momentum. A reaction matrix calculated from the Reid soft-core potential is used. Allowing the Δ isobar to enter as an intermediate particle in the polarization bubbles of the current–current correlation function and including s-wave pion–nucleon interactions, a critical density around two times normal nuclear matter density is obtained. (auth)

35012 HOW PURE ARE SHELL-MODEL WAVEFUNCTIONS? Cole, B. J.; Watt, A.; Whitehead, R. R. (Glasgow Univ. (UK). Dept. of Natural Philosophy). Phys. Lett., B; 55: No. 1, 11-12 (20 Jan 1975).

A simple two-state mixing explanation of the failure of large-scale shell-model calculations to account for the B(MI) value of the $(\frac{1}{2})^+_1 \rightarrow (\frac{3}{2})^+$(g.s.) transitions in ^{23}Na allows an estimate to be made of the purity of the shell-model wavefunctions. The overlap between the shell-model and "true" wavefunctions turns out to be about 80% when the Preedom–Wildenthal interaction is used. (auth)

35013 LEVEL DENSITY FOR DOUBLY ODD DEFORMED NUCLEI. Malov, L. A.; Soloviev, V. G.; Voronov, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). Phys. Lett., B; 55: No. 1, 17-18(20 Jan 1975).

The level density for doubly odd deformed nuclei near B_n is calculated within the framework of the semi-microscopic approach. The calculated values are found to be in good agreement with the experimental ones. It is shown that for the $I \geq 1$ states it is important to take into account rotational motion. (auth)

35014 INVESTIGATIONS ON EXCHANGE TERMS IN HEAVY ION SCATTERING. Clement, D.; Kanellopoulos, E. J.; Wildermuth, K. (Tuebingen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Phys. Lett., B; 55: No. 1, 19-22(20 Jan 1975).

Completely antisymmetrized calculations of heavy ion processes in a microscopic nuclear theory are inaccessible with present-day computing techniques. At sub-Coulomb energies drastic reductions are possible by a systematic selection of contributing exchange integrals. The ^{6}Li–α scattering serves as a test for these simplifications. (auth)

35015 DISAPPEARANCE OF UNLINKED GRAPHS IN FIELD THEORY AND THE MANY BODY PROBLEM. Hall, A. G. (Hull Univ. (UK)). Phys. Lett., B; 55: No. 1, 31-32(20 Jan 1975).

By using the time path method introduced in the non-equilibrium many-body problem, the contribution to perturbation series in field theory or many-body theory from unlinked graphs is shown to vanish identically due to a causality principle. (auth)

35016 IMPROVED SIX-PARAMETER ALPHA–NUCLEUS OPTICAL POTENTIALS. Goldberg, D. A. (Maryland Univ., College Park (USA)). Phys. Lett., B; 55: No. 1, 59-62(20 Jan 1975).

Two phenomenological six-parameter forms for the alpha–nucleus optical potential which give significantly improved fits to intermediate energy elastic scattering data, reducing χ^2/F in most instances by a factor of about three, and in several instances giving χ^2/F of the order of unity are reported. (auth)

35017 EVIDENCE THAT ABSORPTION IN THE $\pi^+\pi^-\pi^-$ SYSTEM IN NUCLEAR MATTER IS STRONGER IN THE $J^P = 0^-$ THAN IN THE $J^P = 1^+$ STATE. Beusch, W.; Polgar, E.; Websdale, D. (European Organization for Nuclear Research, Geneva (Switzerland)); Freudenreich, K.; Gentit, F. X.; Muhlemann, P.; Pernegr, J.; Wetzel, W. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Hochenergiephysik); Astbury, P.; Lee, J. G. Phys. Lett., B; 55: No. 1, 97-100(20 Jan 1975).

In the reaction $\pi^- + A \rightarrow \pi^+\pi^-\pi^- + A$ at 15.1 GeV/c the coherently produced 3π mass spectrum has a broad peak around 1.1 GeV which consists mainly of a $J^P = 1^+$ state and of a smaller fraction of 0^-. Comparing the observed dependence of the production of these diffractive states on the atomic weight A of the target nuclei with the optical model, the absorption of the produced states in nuclear matter has been studied. The following values of the absorption cross sections were found: $\sigma_3(0^-) = 49^{+7}_{-}$ mb and $\sigma_3(1^+) = 15.8^{+}_{-}$ mb. (auth)

35018 THE JOST FUNCTION AND BOUND STATE SOLUTION FOR THE HULTHEN POTENTIAL. Talukdar, B.; Sinha Roy, M. N.; Chattarji, D. (Visvabharati Univ., Santiniketan (India). Dept. of Physics). Nucl. Phys., A; 239: No. 1, 89-92(17 Feb 1975).

The parameters of the attractive Hulthen potential are obtained in terms of the parameters of effective range theory by using the Jost function for the potential. The bound state solution for $l = 0$ is found from the corresponding Jost solution. The possibility of extending the present treatment to higher angular momentum states is discussed. (auth)

35019 THE INFLUENCE OF THE REAL NUCLEAR POTENTIAL ON THE HEAVY-ION ELASTIC CROSS SECTION. Rowley, N. (Paris-11 Univ., 91–Orsay (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 239: No. 1, 134-156(17 Feb 1975).

By using a simple but reasonably realistic form for the long-range part of the real nucleus–nucleus potential, some simple approximations are derived for the nuclear parts of the WKB phase shift and classical deflection function for the elastic scattering of two heavy ions. The formulae are presented in the form of universal functions which allow a rapid evaluation of the approximate "rainbow" angle and angular momentum. The numerical simplicity of this form of the nuclear phase allows a rapid determination of the corresponding cross section using the partial wave expansion. The cross sections show a shift of the quarter-point to forward angles with respect to the corresponding cross section in which the real nuclear potential is ignored. This suggests that critical angular momenta evaluated from the usual quarter-point recipe will generally be an overestimate. It is shown that for very heavy ions the nuclear potential may give a large enhancement of the peak in the elastic cross section, and indirect evidence for this effect is cited. For lighter ions the oscillatory structure of the cross sections appears to be dominated by absorption rather than by the real potential. (auth)

35020 EFFECTIVE TWO-BODY INTERACTION IN SIMPLE NUCLEAR SPECTRA. Molinari, A.; Alberico, W. M. (Turin Univ. (Italy). Istituto di Fisica); Johnson, M. B. (Los Alamos Scientific Lab., N. Mex. (USA)); Bethe, H. A. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Nuclear Studies). Nucl. Phys., A; 239: No. 1, 45-73(17 Feb 1975).

The low-lying spectra of some simple nuclei (two nucleons outside closed shells or the equivalent situations) are analyzed in terms of a force with a short-range component, taken to be a delta force, and a long-range core-mediated component. Formulas are given for the energy splitting among the members of the resulting multiplets. Both the cases of particles sitting in equivalent as well as in nonequivalent orbits are considered. An estimate of the contribution to the residual effective interaction from the different components of the force is obtained by means of a least squares fit to the data. (auth)

35021 EXCHANGE EFFECTS FROM REALISTIC INTERACTIONS IN THE REFORMULATED OPTICAL MODEL. Love, W. G. (Georgia Univ., Athens (USA)); Owen, L. W. (Oak Ridge National Lab., Tenn. (USA)). Nucl. Phys., A; 239: No. 1, 74-82 (17 Feb 1975).

Exchange effects of the knock-on type are found to be well-approximated for elastic scattering by using a zero-range nucleon–nucleon interaction whose energy-dependent strength is determined from distorted-wave calculations. The result is a local but energy-dependent nucleon–nucleus optical potential from which one can readily obtain the variation of its volume integral and mean square radius with projectile bombarding energy. The energy dependence (10 MeV $\lesssim$ E $\lesssim$ 80 MeV) of the volume integral is found to be considerably smaller than that found experimentally, indicating that exchange effects need not be entirely responsible for this variation. (auth)

35022 POTENTIAL-ENERGY SURFACES FOR THE DOUBLY EVEN N = Z NUCLEI. Leander, G.; Larsson, S. E. (Tekniska Hoegskolan, Lund (Sweden). Institutionen foer Matematisk Fysik). Nucl. Phys., A; 239: No. 1, 93-113(17 Feb 1975).

The deformation dependence of the static energy in the doubly even N = Z nuclides from ^{12}C to ^{44}Ti has been determined by the macroscopic–microscopic method. Important features are the consideration of axially asymmetric and reflection-asymmetric shape degrees of freedom and, furthermore, the use of a modified surface-energy term. (auth)

35023 A NEW METHOD FOR SEPARATING THE CENTER-OF-MASS MOTION OF CLUSTERS IN NUCLEI. Furman, V. I.; Holan, S.; Kadmensky, S. G.; Stratan, G. (Joint Inst. for Nuclear Research, Dubna (USSR)). Nucl. Phys., A; 239: No. 1, 114-124 (17 Feb 1975).

A method for separating the center-of-mass motion of a two-or-more-particle cluster is developed. This method works for an arbitrary central shell model potential. Only the internal motion wave function must be previously defined. Formulas are obtained for the case of clusters with arbitrary angular momenta of the internal motion and with constituent particles of unequal masses. The problem of separating the relative motion of a pair of particles with previously defined center-of-mass motion is also solved. As a byproduct, a useful integral formula for generalized Talmi-Moshinsky coefficients is obtained. Some applications of the method are demonstrated in calculating the overlap integrals for radioactive states, the form factors for direct α-transfer reactions and the two-particle interaction matrix elements. (auth)

35024 THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE DOPPLER EFFECT ON NEUTRON RESONANCES. Mateiciuc, V.; Constantinescu, M.; Stadnicov, T. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 19: No. 9, 949-957 (1974).

A theoretical method for the determination of the nuclear parameters using the Doppler effect is presented. One can determine Γ, $g\Gamma n$, $\Gamma\gamma$, as well as σ_0 for different temperatures of the sample, a very important parameter for the nuclear reactors and the power plants design. The theoretical conclusions were verified on the resonance at 6.24 eV in ^{121}Sb. The values are in good agreement with the data compiled from the literature. (auth)

35025 NUCLEAR REACTIONS WITH CORE EXCITATION. Lovas, I. (Kernforschungsanlage, Juelich, Ger.). Ann. Phys. (N. Y.); 89: No. 1, 96-114(Jan 1975).

The transition amplitudes for nucleon scattering, stripping, pick-up, and break-up reactions are derived in the framework of a three-body model. The model consists of two nucleons and a core. The core is assumed to have a discret excitation spectrum. The nucleon-core interactions give rise to the excitation and subsequent deexcitation of the core. The energy averaged transition amplitudes are obtained by iteration from Faddeev-type integral equations. The lowest order terms correspond to the DWBA and the higher order terms describe the multistep processes. (auth)

35026 EFFECT OF COMPOUND STATES ON COLLECTIVE-STATE SINGULARITIES IN THE OPTICAL POTENTIAL. Hahne, F. J. W.; Heiss, W. D. (Atomic Energy Board, Transvaal, South Africa). Ann. Phys. (N. Y.); 89: No. 1, 68-95(Jan 1975).

From an exact form of the self-energy of a nucleon in a nucleus, which is equivalent to the optical potential, two approximation schemes, which are both based on a weak-coupling picture, are presented. They lead to expressions which can be interpreted physically as the coupling of a dressed single-particle (single-hole) state to the exact particle-hole (particle-particle) propagator. The residues of the many poles of the self-energy are divided into two categories: residues which are distributed statistically, and residues which vary systematically. The first set is interpreted as compound nuclear structure and its influence on the single particle motion is investigated. The second set leads to intermediate structure. This structure is further investigated within an extension of the random phase approximation where all particle and hole lines are dressed by compound nuclear effects. In this way the spreading width of intermediate resonances, which is found to be the imaginary part of the pole position in the self-energy, is calculated. The escape width for these resonances is obtained by solving the Lippmann-Schwinger equation in which the calculated self-energy appears. This width depends on the structure of the continuum as well as on the residues of the poles of the self-energy. It is shown that these residues are complex, one of the reasons for this being that corrections to the vertex for the excitation of a collective state, appear. The similarity between the complex form factors introduced in the macroscopic model for inelastic scattering and the complex vertex functions above, is discussed. It is also pointed out that the results obtained here may be used in a phenomenological analysis. (auth)

35027 SECOND QUANTIZATION FOR AN ABSORPTIVE SYSTEM OF MANY COMPOSITE PARTICLES. With Application to Nuclear Reaction Theory. Nishigori, T. (Osaka Univ., Suita (Japan). Faculty of Engineering). Progr. Theor. Phys. (Kyoto); 51: No. 5, 1387-1405(May 1974).

A new Hamiltonian is proposed as a convenient basis for discussing a many composite-particle system in which nuclear reactions take place. Feshbach's projection operators are generalized so as to apply to the many-particle system, and the concept of Dyson's ideal spin-wave states is extended to bound states of many nucleons. The Hamiltonian thus constructed is expressed in terms of nuclear creation and annihilation operators which obey the simple commutation rules. It is shown that, when the present formalism is applied to nuclear reaction theory, the transition amplitude describes in a unified way both the direct and resonant processes, as in Feshbach's unified reaction theory. (auth)

35028 FORM FACTOR SUM RULE AND GIANT MULTIPOLE STATES. Ui, H.; Tsukamoto, T. (Tohoku Univ., Sendai (Japan). Dept. of Physics). Progr. Theor. Phys. (Kyoto); 51: No. 5, 1377-1386(May 1974).

The energy-weighted sum rules for both the form factor and transition charge density are derived, describing longitudinal multipole excitation of nuclear states in electron inelastic scattering. These sum rules are applied to the determination of the transition charge density of the giant multipole state under the assumption that the sum rules are saturated by this single collective state at photon-point. The resulting transition charge density is found to be precisely the same as that of hydrodynamical model by Tassie. The uniqueness of the result is discussed. It is pointed out that the one-term saturation of sum rules at the photon-point alone cannot necessarily determine the transition charge density uniquely except for its behavior near the nuclear surface. Possible corrections to Tassie-type transition charge density are studied by considering higher order giant multipole states whose γ-transition to the ground state is strictly forbidden. The transition charge densities of these higher forbidden giant multipole states are determined by the sum rules. Implications of the results on the experiments of electron scattering are briefly discussed. (auth)

35029 EXTENSION OF THE SINGLE-PARTICLE DESCRIPTION IN NUCLEAR SYSTEM, 2. Derivation of the Model-Space Effective Hamiltonian. Suzuki, K. (Kyushu Inst. of Tech., Kitakyushu, Fukuoka (Japan)); Kumagai, H. Progr. Theor. Phys. (Kyoto); 51: No. 4, 1081-1093(Apr 1974).

The model-space effective Hamiltonian H_{eff} is formulated on the basis of the unitary transformation method. The H_{eff} is obtained through the similarity transformation of the original Hamiltonian. The H_{eff} is proved to be Hermitian and independent of energy eigenvalue. A method is proposed which constructs a perturbative solution for the unitary operator leading to H_{eff}. The connection of model-space wave functions with true eigenfunctions is investigated by means of a quasi-particle picture introduced through the canonical transformation of single-particle operators. (auth)

35030 ISSLEDOVANIYA PO TEORII STRUKTURY LEGKIKH YADER. (Research on the Theory of the Structure of Light Nuclei). Dzhibuti, R. I. (ed.). Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). 90p.

Five articles written by the staff of the Laboratory of Theoretical Nuclear Physics of the Institute of Physics of the Academy of Science, Georgian SSR, are compiled. The structure of light nuclei and the effects of multi-nucleon dynamic correlations in nuclei were studied in the framework of new methods developed in recent years in the area of the theory of low nucleon systems. The theory of unitary transformations is given for the basic of hyperspherical functions in the problem of four bodies with unequal masses. In the framework of this approach the properties of cluster configurations of light nuclei were examined. The four-body problem was examined in the oscillator approach. Equations of the Faddeev-Yakubov type were obtained for four correlated nucleons and the role of three- and four-nucleon dynamic correlations in the nuclei was studied. Separate abstracts were prepared for each paper. (tr-auth)

For abstracts of individual papers see: 34799, 34800, 34822, 34840, and 35031.

35031 MULTI-PARTICLE SHORT-ACTING CORRELATIONS IN NUCLEI. Dzhibuti, R. I.; Kezerashvili, R. Ya. pp 22-55 of Issledovaniya po Teorii Struktury Legkikh Yader. Dzhibuti, R. I. (ed.). Tbilisi, USSR; Izdatel'stvo Metsniereba (1974). (In Russian).

Three-particle correlations in nuclear matrices are first examined. The Rajaraman diagram technique is discussed and it is then used to obtain the Bethe-Faddeev equations in the case of two-particle and three-particle forces. The solutions of the Bethe-Faddeev are examined and used to study the contribution of three-particle correlation in the binding energy of nuclear matrices. Four-particle correlations are then discussed. The four-body equation in nuclear matter was obtained. An approximate solution of this equation was examined. The contribution of four-particle correlation in the binding energy to one particle of nuclear matter is discussed. (JSR)

35032 STUDY OF CROSSING SYMMETRY IN PION-NUCLEUS SCATTERING. Cammarata, J. B. College Park, MD; Univ. of Maryland (1974). 184p. University Microfilms Order No. 75-7822.

Thesis (Ph. D.).

The role of crossing symmetry in the elastic scattering of pions by nuclei is studied using two different approaches. The first approach is based on an optical potential formalism appropriate for relativistic particles. In a second-quantized theory, an operator inversely related to the time-order propagator for a pion in the presence of a finite nuclear system is shown to generate the exact many-body transition operator for elastic pi-nucleus scattering when used in the Lippmann–Schwinger equation. This operator is thus identified as the pion-nucleus optical potential. A second approach to the study of the role of crossing in elastic pion-nucleus scattering is provided by the field-theoretic equation of Low. (Diss. Abstr. Int., B)

35033 SIMULTANEOUS EMISSION OF TWO LIGHT CHARGED PARTICLES IN FISSION. Feather, N. (Univ. of Edinburgh, Eng.). Proc. Roy. Soc. Edinburgh, Sect. A; 71: 323-331(1974).

The suggestion is made that in certain cases the light particles emitted in ternary fission may be released otherwise than in the ground state and, in particular, that low-lying particle-unstable states may be involved. This suggestion is examined quantitatively in respect of the release of ^{8}Be in the first excited short-lived state of 2.9 MeV excitation, and is shown to provide a satisfactory interpretation of the observation of quaternary fission in the α,α mode recently reported by Kataria et al. (Preprint IAEA-SM-174/63. (1973)). It appears probable that the other modes of quaternary fission observed by these authors should be similarly interpreted. (auth)

35034 ORIGIN OF THE SHORT-RANGE ALPHA PARTICLES OF FISSION. Feather, N. (Univ. of Edinburgh, Eng.). Proc. Roy. Soc. Edinburgh, Sect. A; 71: 285-292(1974).

The suggestion is made and rendered plausible by detailed calculation, that the short-range α-particles of fission, identified by Kugler and Clarke (Phys. Rev.; C5: 551-560 (1972)), are emitted, in competition with "prompt" γ-rays, from highly excited post-neutron-emission fragments of even neutron number N and, predominantly, of mass number A in the range $140 \leq A \leq 145$. A similar process is energetically forbidden in relation to triton emission. (auth)

35035 NUCLEAR STRUCTURE WITH SKYRME INTERACTIONS. Sharp, R. W. Jr. New Brunswick, NJ; Rutgers–The State Univ. (1974). 165p. University Microfilms Order No. 75-8442.

Thesis (Ph. D.).

The Skyrme class of potentials (in particular, those of Vautherin and Brink, and Moszkowski) is studied in the context of nuclear structure calculations. The arguments in favor of a density-dependent G matrix are reviewed. It is argued that harmonic oscillator wave functions are good approximations to the nuclear single-particle wave functions if the oscillator constant is chosen to give the correct nuclear radius and if radially self-consistent forces are used. The proper use of density-dependent forces for calculating particle–hole and particle–particle spectra is considered, and the rearrangement corrections are stated. The nuclear structure quantities studied are the energies of the giant multipole resonance collective states, effective charges, and particle–particle and particle–hole spectra near the closed shells ^{16}O and ^{40}Ca. The isobaric analog and giant dipole states of ^{208}Pb are also considered. The effect of density dependence on monopole quantities leads to a more detailed study of the breathing mode state in the RPA and TDA formalisms. The RPA calculation shows a lack of enhanced collectivity compared to the TDA calculation, and the TDA calculation fulfills the energy-weighted sum rule for the present Skyrme forces which give high nuclear compressibilities. Finally, the matrix elements for particle–particle and particle–hole spectra are studied in detail. It is concluded that an s-wave force (which does not allow independent variation of spin and isospin parameters) can not be given a spin dependence which will simultaneously fit both spectra. (RWR)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 33237, 33241, 33437, 34071, and 34541.

35036 (AED-CONF-74-509-006) NEUTRON COLLIMATOR CALCULATIONS. Gruenauer, F. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Strahlenschutz). 1974. 7p. INIS.

From 2nd symposium on neutron dosimetry in biology and medicine; Neuherberg/Muenchen, F. R. Germany (30 Sep 1974). Available from ZAED.

The following conclusions are drawn from calculations for a 15 MeV source: radiation transport calculations can provide data at least as reliable as measurement; the influence of the treatment room on the dose distribution in a phantom is as important as the influence of collimator and shield; simple-layered shields are superior to multi-layered ones, especially with regard to RBE dose; and RBE dose profiles are less favorable than the energy dose profiles. (GE)

35037 (JAERI-M-5567, pp 210-214) MEASUREMENT OF EQUILIBRIUM CHARGE DISTRIBUTION WITH A THICK TARGET. Ozaki, J.; Nakata, A.; Kido, Y.; Asari, M.; Fukuzawa, F. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

Combinations of a position sensitive detector and an electric or a magnetic field are shown to be suitable for measurement of the equilibrium charge distributions of the scattered ions from a thick target. Experimental results agree well with the semi-empirical estimations. Measurements at different scattering angles show that the inner shell ionizations caused by violent collisions do not affect the charge distributions in this measurement. (auth)

35038 (JUL-1047-KP) APPLICATION OF THE CHANNELING EFFECT TO STUDY THE ATOMIC INTERACTION OF HIGH-ENERGY PARTICLES. Ambros, R. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik; Koeln Univ. (F. R. Germany)). Feb. 1974. 98p. (In German). INIS.

The ion-atom interaction was investigated by using the channeling effect of high-energy ions in plane channels of thin gold monocrystals. The parameters of a repulsive model-plane interaction potential of the form $V(y) = A \cosh By$ were determined by two different experiments: The parameters of the plane interaction potential for 2 MeV α-particles by measuring the microstructure in the channeling angle distributions after transmission of the ions through Au-(1, 0, 0)-plane channels; depth of the potential well $A_{100} = 11$ eV, screening constant $B = 3.33\ A^{-1}$. For 60 MeV iodine, the potential parameters were determined by the energy loss structure after transmission through Au-(1, 0, 0) and Au-(1, 1, 1)-plane channels; depth of the potential well $A_{111} = 83 \pm 22$ eV, $A_{100} = 129 \pm 33$ eV, screening constant $B = 3.68 \pm 0.45\ A^{-1}$. The characteristic I-M, Au-M and I-L X-radiation excited in the (1, 1, 1)-plane channel, was measured in coincidence with iodine ions of a certain energy loss. The X-ray excitation per ion as function of the oscillation amplitude was obtained from which the collision parameter dependence of the X-ray yield $p(\varphi) = C \exp(-D\rho^2)$ in binary collision could be determined. (GE)

35039 (LA-5903-MS) MONTE CARLO CODE DEVELOPMENT IN LOS ALAMOS. Carter, L. L.; Cashwell, E. D.; Everett, C. J.; Forest, C. A.; Schrandt, R. G.; Taylor, W. M.; Thompson, W. L.; Turner, G. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1975. Contract W-7405-eng-36. 7p. Dep. NTIS $4.00.

The present status of Monte Carlo code development at Los Alamos Scientific Laboratory is discussed. A brief summary is given of several of the most important neutron, photon, and electron transport codes. (auth)

35040 RADIATION QUALITY OF FIELDS PRODUCED BY 16-, 30-, AND 50-MeV DEUTERONS ON BERYLLIUM. Oliver, G. D. Jr.; Grant, W. H. III; Smathers, J. B. (Univ. of Texas, Houston). Radiat. Res.; 61: No. 3, 366-373(Mar 1975).

The distributions of dose in linear energy transfer were measured for three primary beams of neutrons being developed for radiotherapy applications. The neutron beams, collimated to 15×15 cm^2, were produced by 16-, 30-, and 50-MeV deuterons impinging upon a beryllium target. The relative changes in the distributions have been correlated with incident deuteron energy, depth in tissue, and scattering media. Thicker beryllium targets decreased the dose distributions of the resultant beam. Spectral distributions of scattered beams taken in air out of the primary field exhibited considerable shift to lower values. Dose average LET values over the limited range of 1 to 500 keV μm were determined as a function of depth for each energy beam. The results were favorable in relation to the anticipated use of higher energy neutron beams for radiation therapy. (auth)

35041 ULTRASOFT X-RAY ABSORPTION MEASUREMENTS USING A PHOTOELECTRON SPECTROMETER. Keski-Rahkonen, O. (Oak Ridge National Lab., TN). J. Phys., C. (London); 8: No. 4, 541-549(21 Feb 1975).

The feasibility of measuring by the PAX technique (photoelectron analysis of x rays) continuous absorption profiles in the ultrasoft x ray region was explored. Bremsstrahlung from a tungsten anode bombarded with 1 to 5 keV electrons served as a radiation source. Photoelectrons ejected by x rays from the neon converter atom were analysed with a spherical electrostatic electron spectrometer having an instrumental resolution of $\Delta E/E = 0.15\%$. As an example, absorption structures at the Sm $N_{4,5}$ and Al $L_{2,3}$ edges were measured and compared with results obtained at the DESY synchrotron. A brief evaluation of the technique is presented and some possible applications are discussed. (auth)

35042 RELATION BETWEEN ENERGY AND PRACTICAL RANGE, FOR 10-30 MeV ELECTRONS. Hoshino, K.; Inada, T.; Matsuzawa, H. (National Inst. of Radiological Sciences, Chiba (Japan)). Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 6, 433-439(Jun 1974). (In Japanese).

This investigation was performed for electrons generated by betatron with nominal energies between 10 to 29 MeV. The spectral distribution of electrons was measured using a magnetic spectrometer. On the basis of measured spectrum, the maximum energy, $(E_{max})_0$, the most probable energy, $(E_p)_0$, and the mean energy, E_0, were determined at the surface of phantom. On the other hand, the practical range in water, R_p, was measured from depth ionization curve obtained with a thimble ionization chamber in water phantom. Thus, the following conclusions were drawn from the experimental results, for electrons falling on the phantom surface. (1) The relation between $(E_p)_0$ and R_p may be approximated by an empirical formula $R_p = 0.53\ (E_p)_0 + 0.20$, where $(E_p)_0$ and R_p are expressed in MeV and cm units, respectively. (2) The relation between E_0 and R_p will not be given by a single formula, since the relation changes depending on the thickness of scattering foil. (3) The maximum energy, $(E_{max})_0$, will be close to accelerator energy E_a, so long as the collision energy loss of electrons is less than about 2 MeV before they reach the phantom surface. (4) E_a may not be directly related to R_p by a single formula. However, if it is possible to calculate the collision energy loss ΔE_{col}, of electrons before reaching the phantom surface, E_a may be given by $(E_p)_0$ plus ΔE_{col}. (auth)

35043 BASIC CONCEPT OF RADIATION DOSIMETRY. Moriuchi, Y. (Electrotechnical Lab., Tokyo (Japan)). Genshiryoku Kogyo; 20: No. 5, 9-14(May 1974). (In Japanese).

A theoretical explanation is attempted on radioactivity and radiation, the concept of radiation dose and dosimetry, etc., specifically assuming environmental radiation dosimetry. Properly speaking, generally mentioned "radiation" should be named "ionizing radiation" and should be recognized clearly for its origin of generation. As for radiation dose, ICRU defines only the absorption dose as the basic dose. It is well known that the name "dose equivalent" is given when the consideration for biological effect is added. In physical quantities similar to "dose" in wide meaning, there are "exposure" in the Röentgen unit and "kerma" in Rad. On the contrary, though the unit "rep" is still seen in commercially available books, it has no meaning since it was abolished 20 years ago. (JA)

35044 COMPARISON OF THE ISODOSE CURVES BY THE DIFFERENCES AMONG TUMOR SOURCE DISTANCES AND/OR DIAMETERS OF BODY CROSS SECTION. Calculation of Various Isodose Curves in Telecobalt Therapy by Small Computer. Ohshima, M.; Yasukochi, H.; Machida, K.; Kumura, F.; Sugawara, T. (Tokyo Univ. (Japan). Faculty of Medicine). Nippon Igaku Hoshasen Gakkai Zasshi; 34: No. 4, 212-219(Apr 1974). (In Japanese).

The results of dose distribution calculated by the computer in some representative cases are shown. According to observations, it was revealed that the relative dose distribution has almost no

relation to the size of human body and the source-tumor distance, at least in the cancer of maxilla, esophagus, and uterine cervix according to the technique. When the same irradiation technique was used if source-tumor distance was changed from 50 to 100 cm, almost no difference among dose distribution curves within the patient was found, even though the size of human body of the Japanese changed within one standard deviation. In the case of maxillary carcinoma, the most effective technique for irradiation is the rectangular crossing anterior and lateral fields with 45° wedge filters, and the most unsuitable is the two rectangular crossing fields without wedge filters, because the dose distribution on the center of the human body is unacceptably low. In esophageal cancer, the anterior and posterior two opposite field irradiation is adequate from the view point of lower pulmonary dose, and the one anterior and two posterior oblique field irradiation is also good because of lower dose of spinal irradiation. Another reason why two opposite fields were applied is the clinical experience that the geometrical separation between esophagus and spine in determining irradiation field is very difficult. Moreover, it was found that the rotation technique is unsuitable as pulmonary dose is higher than the above-mentioned methods. In the case of carcinoma of the uterine cervix, the same dose was given equally to the area between A-points and B-points in calculation. For this purpose it is reasonable to give at least 70% dose of teletherapy dose at B-point by the intracavity small sources in pendulum irradiation, and it is necessary to irradiate 60% dose to the same area by small sources in six-field irradiation method. (auth)

35045 ELECTRON ENERGY LOSS SPECTRA OF THE SOLID RARE GASES FOR LOW PRIMARY BEAM ENERGIES. Nuttall, J. D.; Gallon, T. E.; Devey, M. G.; Matthew, J. A. D. (York Univ., Eng.). J. Phys., C (London); 8: No. 4, 445-458(21 Feb 1975).

The high resolution electron energy loss spectra of solid xenon, solid krypton and solid argon have been measured at 10K with primary beam energies in the range 100 to 1000 eV. The spectra are interpreted in terms of excitons, plasmons, interband transitions and ionizations of inner shells. The classifications of the lower resolution differentiated spectra of Farrell and Strongin (Phys. Rev.; B6: 4711(1972)) have been clarified and extended. (auth)

35046 TRANSMISSION OF BETATRON BREMSSTRAHLUNG THROUGH MATERIALS. Hyodo, T. (Kyoto Univ. (Japan). Faculty of Engineering). Bull. Inst. Chem. Res., Kyoto Univ.; 52: No. 1, 1-7(Jul 1974).

Attenuation of dose rate of bremsstrahlung produced by 20 and 32 MeV electrons was calculated using attenuation kernel method for iron, lead, ordinary concrete, and heavy concrete barriers. The results are shown as attenuation curves. (auth)

35047 MEASUREMENTS OF BREMSSTRAHLUNG SPECTRA AND TOTAL PHOTON ABSORPTION CROSS SECTIONS FOR ELEMENTAL MATERIALS. Sugiyama, S. (Electrotechnical Lab., Tokyo (Japan)). Denshi Gijutsu Sogo Kenkyusho Kenkyu Hokoku; No. 44, 1-56(Mar 1974).

A novel system for the energy spectrum measurements of bremsstrahlung beam from high energy electron accelerators has been established by the use of a new type of high efficiency magnetic pair spectrometer. The total photon absorption cross sections for water, magnesium, niobium and bismuth have been determined at photon energies from 6 MeV to 25 MeV with this measuring system. An improvement on a magnetic pair spectrometer has been carried out by the use of two current spark chambers as ladder counters in an ordinary type pair spectrometer. This attempt increased the detection efficiency of the spectrometer to 10^3 times as large as that of the ordinary type pair spectrometer. The detection efficiency of this spectrometer is estimated to be 3.5 counts/erg for the bremsstrahlung with the maximum energy of 25 MeV. The total photon absorption cross sections for water, magnesium, niobium and bismuth were measured with the attenuation method in the giant dipole energy region. The photonuclear absorption cross sections for these materials were determined by the subtraction of the electronic contribution from the total absorption cross sections. The isospin splittings were found in the electric dipole transition of Nb and Bi. Peak photoproton cross sections corresponding to the T-upper states in Nb and Bi are 50 ± 20 mb at 21.2 MeV and 80 ± 50 mb at 22.5 MeV, respectively. The giant dipole resonance peaks of Nb and Bi are located at 16.5 MeV with the maximum values of 205 mb and 13.7 MeV with the maximum value of 660 mb, respectively. The separation energies between the two resonance peaks corresponding to the T-upper and T-lower states are 4.7 MeV and 8.8 MeV for Nb and Bi, respectively. Comparison with the available results on other nuclei suggests that the V value given by the separation energies between two resonance peaks is distributed from 60 MeV to 100 MeV and depends on the atomic mass number of the nuclei. (auth)

35048 MOTION OF A FAST ION IN PERIODIC POTENTIALS. Kondo, J. (Electrotechnical Lab., Tanashi (Japan). Tanashi Branch). J. Phys. Soc. Jap.; 36: No. 5, 1406-1408(May 1974).

A quantum mechanical calculation of excitation probability of a fast ion passing through a crystal, when ion's excitation energy ΔE satisfies Okorokov's condition $\Delta E = hv/a$ (h: Planck's constant, v: the velocity of the ion, a: the atomic distance of the crystal) is presented. It is found that the probability is a sinusoidal function of the distance and can reach unity when the ion beam is mono-energetic. The wavelength of the sinusoidal function is determined by the (low-order) Fourier component of the periodic potential of the crystal, thus providing a method to measure the latter experimentally. (auth)

35049 TOTAL GAMMA-RAY CROSS SECTIONS IN ALLOYS IN THE ENERGY REGION 145 TO 1330 keV. Rao, K. S. S.; Prasad, G. A.; Rao, B. V. T.; Rao, P. V. R.; Parthasaradhi, K. (Andhra Univ., Visakhapatnam, India). Indian J. Phys.; 48: No. 8, 763-765(Aug 1974).

The total cross sections in monel metal and steel (W 23%, C 0.77%, Cr 4.25%, V 1.6%, Co 11%, Fe 59.38%) were measured at gamma energies from 145 to 1330 keV. The cross sections were determined by transmission measurements with a NaI(Tl) crystal. Experimental and theoretical values agreed within 7%. (1 table) (RWR)

35050 ESTIMATION OF ION SCATTERING BY ATOMIC CHAINS ON SINGLE CRYSTAL SURFACES. Marchenko, S. D.; Parilis, E. S.; Turayev, N. Y. (Inst. for Electronics, Tashkent). pp 99-101 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

Estimation of ion movement close to atomic chains taking into account the elastic and inelastic energy losses and vacancy type imperfections was performed on the basis of a model of binary interactions of ions with the atoms of a crystal. An analysis of results shows that at scattering by atomic chains, a phenomenon which makes a substantial contribution to scattering by the single crystal surface, the inelastic energy losses exceed the single scattering ones by a factor of 5-6. (auth)

35051 PECULIARITIES OF ION SCATTERING BY CRYSTALS DUE TO SURFACE HALFCHANNELS, FORMED BY CLOSE PACKED ATOMIC ROWS. Skripka, Yu. G. (Donetsk State Univ., USSR). pp 103-105 of Ion Surface Interaction, Sputtering, and Related Phenomena. Behrisch, R. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1973).

From international conference of ion surface interaction, sputtering and related phenomena; Munich, F. R. Germany (24 Sep 1972). See CONF-7209125-.

The ion scattering by the surface of crystals has been studied when there are halfchannels on the crystal surface, which are formed by close packed atomic rows of the first and the second layers of crystals. Results are compared with one of ion scattering by directions, which have no surface halfchannels. (auth)

35052 MODIFICATIONS IN THE SPECTRA OF LOW-ENERGY PHOTON SOURCES PRESENT IN TISSUE-EQUIVALENT MEDIA. Unnikrishnan, K.; Sharma, R. C.; Somasundaram, S. (Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.). Nucl. Instrum. Methods; 123: No. 3, 557-562(1 Feb 1975).

Modifications in the pulse-height spectra, obtained with a thin NaI(Tl) detector, for monoenergetic low-energy photon (LEP) sources present in water have been studied by performing Monte Carlo calculations with a view to facilitating proper assessment of LEP sources in vivo. The two specific characteristics studied are (a) shift in the photopeak energy and (b) deterioration of energy resolution, both in relation to the spectrum from a bare source. Data on these changes for various energies up to 100 keV and depth of immersion of a point source in water up to 12 cm have been generated theoretically. Results for a source of ^{241}Am at a depth of 6.3 cm in water were verified experimentally. The individual roles of scattering in the intervening medium and of finite energy resolution of the detector in bringing about the observed spectral changes are discussed on the basis of the theoretical results. (auth)

35053 ANGULAR STRAGGLING OF HEAVY AND LIGHT IONS IN THIN SOLID FOILS. Spahn, G.; Groeneveld, K. O. (Frankfurt Univ. (F. R. Germany). Inst. fuer Kernphysik). Nucl. Instrum. Methods; 123: No. 3, 425-429(1 Feb 1975).

Angular straggling of projectiles (H, He, N, Ne) in solid targets (C, Al, Ni, Sb, Ag, Au) was measured in the projectile energy range $1 \leq E_p \leq 11$ MeV. The angular straggling width σ has been studied as a function of target thickness, projectile energy and atomic number of target. Existing theories (Fermi, Williams and Moliere) are extended to heavy ions and, together with Meyer's theory, compared with the experimental results. The agreement between theoretical and experimental values is not better than 25%. (auth)

35054 $Z^{\frac{1}{3}}$ EFFECT ON THE STOPPING POWERS OF SEVERAL METALLIC ELEMENTS FOR 28.8 MeV ALPHA PARTICLES: DEVIATIONS OF EXPERIMENTAL DATA FROM THEORIES. Ishiwari, R.; Shiomi, N.; Shirai, S. (Nara Women's Univ. (Japan). Dept. of Physics). Phys. Lett., A; 51: No. 1, 53-54(27 Jan 1975).

Stopping powers of several metallic elements for 28.8-MeV alpha particles have been measured. One-fourth of the stopping power for alpha particles is larger than the stopping power for protons of the same velocity. But the differences do not agree with $Z^{\frac{1}{3}}$ correction theories. (auth)

35055 THE MEASURED ENERGY LOSS OF HIGH ENERGY ELECTRONS IN VARIOUS METALS. Buskirk, F. R.; Dyer, J. N.; Maruyama, X. K.; Woehler, K. E. (Naval Postgraduate School, Monterey, Calif. (USA)). Z. Phys.; 271: No. 2, 69-73(Dec 1974).

The energy distribution of electrons of about 53, 75 and 93 MeV has been measured before and after passing through Be, Sn and Gd absorbers of various thicknesses. Earlier data for Al, Cu and Pb absorbers are reviewed. The electrons were accelerated by the LINAC of the Naval Postgraduate School. The most probable energy loss and the half widths agree with the theory of Blunck and Westphal. An improved semi-empirical formula for the most probable energy loss is presented. (auth)

35056 ON THE ANALYTICAL APPROACH TO THE AGE-DIFFUSION EQUATION IN ELECTRON TRANSPORT PROBLEMS. Minato, S. (Government Industrial Research Inst., Nagoya (Japan)). Nagoya Kogyo Gijutsu Shikensho Hokoku; 23: No. 1, 1-9(Jan 1974). (In Japanese).

Electron transport problems in an infinite medium were solved using an age-diffusion equation. The age "τ" appearing in the age-diffusion equation was given by empirical equations. Values obtained from these empirical equations agreed with those obtained from numerical calculations of τ within 10%. Solutions of the age-diffusion equation were compared with the results of Monte Carlo calculations. Electron transport phenomena could not be explained completely by the age-diffusion equation. A new model for the electron transport phenomenon was suggested in order to improve the form of the age-diffusion equation. (auth)

35057 NONLINEAR SELF-CONSISTENT CALCULATIONS OF RADIATION INDUCED CYLINDER SKIN CURRENTS. Hill, J. R.; Wilson, M. R. (Mission Research Corp., Albuquerque, NM). IEEE Trans. Nucl. Sci.; NS-21: No. 6, 264-270(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

The particle method of numerical plasma simulation is applied to the calculation of surface currents on a metallic cylinder in air, exposed to an axially directed planar wavefront of gamma radiation. Assuming a collision-dominated plasma, the Compton electron trajectories, rate equations for the production of secondary electrons and the Maxwell equations are advanced self-consistently for each time step at all mesh cells in the finite difference solution. Numerical results presented include comparisons of self-consistent skin currents with results obtained by prescribing (no field reaction) the Compton current density and ionization rate proportional to the gamma flux. With a $\sin^2$ pulse of 40 ns duration and a relative air density of .1, the self-consistent surface current magnitudes lie considerably below prescribed source results for peak gamma dose rates $\gtrsim 10^{11}$ Rad/sec. At 10^9 Rad/sec, the skin currents from the particle calculations are nearly identical with currents resulting from a prescribed source obtained from the electron dynamics in the absence of the Lorentz force. (auth)

35058 PHOTO-COMPTON CURRENTS AT MATERIAL INTERFACES: THEORY AND EXPERIMENT. Dellin, T. A. (Sandia Labs., Livermore, CA); Dolan, K. W.; MacCallum, C. J. IEEE Trans. Nucl. Sci.; NS-21: No. 6, 227-234(Dec 1974).

From annual conference on nuclear and space radiation effects; Fort Collins, CO (15 Jul 1974).

Analytical formulas are presented for the electron number current, energy current and energy deposition at the photon irradiated interface between different materials. Representative results are shown and compared with previous experimental data. Experimental results are given for the electron number current as a function of interface materials, photon spectrum and photon angle of incidence. The experimental results are compared to the predictions of the analytical formulas and the Monte Carlo code SANDYL. (auth)

Radiation Protection Standards

Refer also to abstracts 33449, 33541, and 34629.

Radiation Source Calibration and Standardization

35059 (COO-1779-151) ENERGY AND INTENSITY CALIBRATION STANDARDS. Firestone, R. B. (Michigan State Univ., East Lansing (USA)). 1974. 33p. Dep. NTIS $4.75.

Gamma-ray energy and intensity standards for various isotopes are tabulated. (LBS)

35060 CALORIMETRIC MEASUREMENTS OF CHARACTERISTICS OF RADIOACTIVE ISOTOPES AND NEUTRON SOURCES. Chapter 4. Shimanskaya, N. S. pp 118-130 of Ionizing Radiation Calorimetry. Moscow; Atomizdat (1973). (In Russian)

This chapter considers the use of the calorimetric method for measuring the average energies of beta spectra, the absolute yields of gamma emitters and the specific yield of neutron sources of the (alpha, n) type. The results of all calorimetric determinations of the average beta energies of various radioactive isotopes carried out up to 1973 are presented in tabular form. A short historical review is given on the results and techniques of calorimetric measurements on the kinetic energy of fission fragments from heavy nuclei. (INIS)

Shielding Calculations and Experiments

Refer also to abstracts 34149, 35312, 35313, and 35507.

35061 COATING MATERIAL FOR ABSORBING BACK-SCATTERING AND PENETRATING RADIATION OF LOW ENERGY X-RAYS OR GAMMA-RAYS. Tanaka, G.; Sonoki, I. (to Giken Kogyo Co., Tokyo (Japan)). Japanese Patent 1973-11568/B/. 3 Oct 1968. 6p. (In Japanese).

A mixture of lead compound of weight ratio 70 to 90%, iron or iron compound of 5 to 25% and calcium compound of 5 to 10% is mixed with a vehicle consisting of coating film forming agent of 25 to 50%, adhesive power strengthening agent of 10 to 20% and scattering wetting agent of 2 to 10%. The x-rays or γ-rays may be absorbed by lead to be converted into a characteristic x-ray which is converted into another characteristic x-ray by iron. Furthermore, another conversion into another characteristic x-ray is made by calcium. The rest of the x-rays or γ-rays may be absorbed by the vehicle, lead, iron and calcium which solidifies these compounds. Compton scattering radiation may be absorbed by the lead. The addition of the vehicle to the filling mixture allows the coating work to be easily done over a long period and for the coating film to be uniformly produced. An application of the coating material thus applied to the surface of mortar or similar material causes scattering radiation to be absorbed by the absorbing coating layers, thereby protecting operators working between the shielding walls from radiation hazards. The coats free from cracking or separating are capable of contacting the foundation of the mortar or similar material. (JA)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 34582, 34728, and 35125.

35062 (JINR-E4-8543) EVALUATION OF FRESNEL'S CORRECTIONS TO THE EIKONAL APPROXIMATION BY THE METHOD OF SEPARABILIZATION. Musakhanov, M. M.; Zubarev, A. L. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 9p. Dep. NTIS (US Sales Only) $4.00.

A method is suggested for separabilization of the potential by means of the solutions of the Schrödinger equations resulting in the Schwinger variational principle for the scattering amplitude. The results are applied to the calculation of the Fresnel's corrections to the Glauber approximation. (auth)

35063 (JINR-P2-8349) PLANCK CONSTANT H AND COMPLEMENTARITY PRINCIPLE IN QUANTUM MECHANICS. Podgoretskii, M. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The physical sense of the complementarity principle in quantum mechanics is analyzed. It was shown that the reasons for appearance of the quantum mechanical complementarity are not reduced to the finiteness of the quantum of action. (auth)

35064 RELATIVISTIC HAMILTONIAN EQUATIONS FOR ANY SPIN. Guertin, R. F. (Rice Univ., Houston, TX). Ann. Phys. (N. Y.); 88: No. 2, 504-553(Dec 1974).

The 2(2J + 1)-component Poincare-invariant Hamiltonian theories that describe free particles of definite mass and spin and that are subject to the conditions every observable φ is either Hermitian or pseudo-Hermitian (i.e., $\varphi = \rho_3\varphi^+\rho_3$) and the theory is invariant under the discrete symmetries are discussed. The treatment is based on the Heisenberg equations of motion and on the Lie algebra of the Poincare group. Explicit formulas are found for the generators of this algebra, including the Hamiltonian H, and all relations between the operators Γ and H that are both necessary and sufficient for $K = \frac{1}{2}[x, H]_+ + \Gamma$ to generate Lorentz boosts are found. To illustrate the utility of the results, they are applied to obtain explicit generalizations of the Dirac equation to any spin, by requiring that $\Gamma = 0$, and of the Sakata-Taketani spin-0 and spin-1 equations to any spin, by requiring that $\Gamma = -\rho_3(1/2m)S \times p$. (auth)

35065 NORMALIZATION OF WAVE FUNCTIONS FOR BOUND STATES IN A SINGLE-WELL POTENTIAL WHEN CERTAIN PHASE-INTEGRAL APPROXIMATIONS OF ARBITRARY ORDER ARE USED. Froeman, P. O. (Univ. of Uppsala). Ann. Phys. (N. Y.); 88: No. 2, 621-630(Dec 1974).

Simple final formulas are obtained for the normalization factors of wave functions for bound states in a one-dimensional, single-well potential, when use is made of certain arbitrary-order phase-integral approximations, which may be modified in a convenient way. (auth)

35066 QUESTION OF INVESTIGATION OF THE HYPERFINE AND SUPERFINE INTERACTION BY THE LIGHT ECHO METHOD. Kaveeva, Z. M.; Samartsev, V. V. Opt. Spectrosc. (USSR) (Engl. Transl.); 37: No. 4, 465(Oct 1974).

Translated from Opt. Spektrosk.; 37: No. 4, 812(Oct 1974).

It is pointed out that for the treatment of the hyperfine and superhyperfine interaction by the light echo method the density matrix of the electron system at a certain time has a given form, and that ultimately the calculation gives a given expression for the modulation factor. (JFP)

35067 REIMANN RECURRENT SPACES CONFORMAL TO EINSTEIN SPACES. Srivastava, R. Istanbul Univ. Fen Fak. Mecm., Seri A; 37: 135-140(1974).

Some conditions are obtained for Riemann spaces which are Ricci-recurrent (i.e., whose curvature tensors R^i_{jkl} satisfy the differential equations $R^i_{jkl,p} = K_p R^i_{jkl}$ where a comma before an index denotes covariant differentiation with respect to the coordinate corresponding to the index and $K_p \neq 0$) and conformal to Einstein spaces (i.e., n-dimensional Riemann spaces for which $R_{ij} = 1/n\, R\, g_{ij}$). (auth)

35068 COMMENT ON THE GROUND-STATE ENERGY FORMULA FOR INTERACTING MANY-PARTICLE SYSTEMS. Yasuhara, H. (Tohoku Univ., Sendai). Lett. Nuovo Cim.; 12: No. 11, 418-420(15 Mar 1975).

A new expression for the ground-state energy formula for interacting many-particle systems is found, and some implications for a homogeneous electron gas are discussed. (JFP)

35069 YANG-LEE DISTRIBUTION IN THE β PLANE. Elvey, J. S. N. (Bedford Coll., London). J. Phys., A (London); 7: No. 15, 1891-1894(11 Oct 1974).

An earlier result obtained by Elvey (Phys. Lett.; 42A: 415 (1973)) giving the Yang-Lee distribution in the β plane for one-dimensional continuum systems of particles with hard cores and nearest-neighbour "rational step potentials" is here extended to general nearest-neighbour potentials. (auth)

35070 COMPARISON OF FIELD-THEORETIC, CORRELATED BASIS FUNCTION, AND COLLECTIVE-CO-ORDINATE RESULTS FOR THE BOSE GAS. Family, F. (Clark Univ., Worcester, MA); Gould, H. Lett. Nuovo Cim.; 12: No. 10, 337-341(8 Mar 1975).

Various results of the approaches of the correlated basis functions and collective coordinates methods for the static structure function of a high density charged Bose gas at zero temperature are compared with a rigorous microscopic calculation. It is found that a previous result breaks down in the first order beyond the Bogolubov approximation due to the approximation of a certain overlap matrix element involving the three-particle distribution function and that a collective coordinate calculation of the excitation spectrum is not complete. It is also found that the impressive quantitative agreement previously found with the experimental results for the excitation spectrum using the collective coordinate method is fortuitous because of some of the approximations and assumptions made. (JFP)

35071 A REMARK ON THE COLLISIONAL INVARIANTS OF THE FINITE QUANTUM SYSTEMS. Grecos, A. P. (Brussels Univ. (Belgium). Faculte des Sciences). Phys. Lett., A; 50: No. 6, 419-421(13 Jan 1975).

The behavior of the constants of motion with respect to the collision operator is discussed in the case of a finite quantum system. (auth)

35072 OPERATOR EQUIVALENTS WITHOUT THE USE OF CLEBSCH-GORDAN COEFFICIENTS. Bose, A. K. (Montreal Univ., Quebec (Canada). Dept. of Physics). Phys. Lett., A; 50: No. 6, 425-426(13 Jan 1975).

The operator equivalent O^k_q is expressed as the q-th difference of O^k_0 for which a two-term recurrence relation is derived. The differences contain simple products of Stirling numbers and binomial coefficients. (auth)

35073 HAMILTONIANS WITH HARTREE-FOCK SOLUTIONS IN THE THERMODYNAMIC LIMIT. Baltensperger, W.; Denoth, J. (ETH Hoenggerberg, Zurich). Collect. Phenomena; 2: No. 1, 3-7 (Jan 1975).

A variational fermion state is considered which, in the thermodynamic limit, gives nonvanishing expectation values only for terms bilinear in the fermion operators belonging to any orbital wave. With repulsive interactions the energy becomes minimum when the state takes a Hartree-Fock form. This solution is shown to become exact in the thermodynamic limit for a Hamiltonian reduced to bilinear terms. (auth)

35074 GRAPHICAL CALCULUS FOR RELATIVISTIC WAVE EQUATIONS. Biritz, H. (Georgia Inst. of Tech., Atlanta). Nuovo Cim.; 25B: No. 1, 449-478(11 Jan 1975).

For practical calculations with relativistic wave equations one describes a graphical formalism based on the techniques developed for angular-momentum analysis. The usefulness of this formalism to obtain some new and deeper results about the general theory of relativistic wave equations is demonstrated. One considers the generalized Dirac matrices, their commutation relations, the corresponding mass spectrum and the g-factors. (auth)

35075 THEORY OF QUASI-STEADY STATES. Greiser, A. I. (Rostov State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 43-46(1974). (In Russian).

On the basis of the assumption of exponential law for the decay of a quasi-steady state, an integral equation was obtained for the wave function of the quasi-steady state ψ^+ and an expression for the energy displacement ΔE was derived. As a corollary of the relations for ψ^+ and ΔE, formulas were obtained for the probability of decay and the optical theorem for the quasi-steady state. The relation of the decay amplitude and the resonance scattering amplitude was also obtained. (tr-auth)

35076 LOW FREQUENCY ASYMPTOTICS OF THE GREEN FUNCTION AND THE KINETIC EQUATIONS FOR A FERMI–BOSE–GAS. Andrianov, V. A.; Popov, V. N. Vestn. Leningrad. Univ., Fiz., Khim.; 16: No. 3, 7-15(Aug 1974). (In Russian).

The diagrams which give the main contribution to the low frequency asymptotics of the Bose one-particle Green function below the Bose-condensation point are obtained by the path-integration method. The summation of the obtained series of diagrams is equivalent to solving a system of kinetic equations. In the hydrodynamical region the solution obtained gives the Green function with poles corresponding to the first and second sounds and to thermal conductivity. At the zero temperature the Green function has poles corresponding to the zero and first sounds. (auth)

35077 CONSTRUCTION AND COMPARISON OF FINITE DIFFERENCE ANALOGS OF SOME FINITE ELEMENT SCHEMES. Swartz, B. K. (Los Alamos Scientific Lab., NM). pp 279-312 of Mathematical Aspects of Finite Elements in Partial Differential Equations. San Francisco; Academic Press, Inc. (1974).

Three subjects are considered. First, the notion of the resolving power of approximation methods, i.e., the number of intervals (or function values) per wavelength necessary to attain a preassigned error when approximating a given frequency, permits the evaluation of the relative efficiency of three types of spatial differencing used in setting up differential-difference equations for the 1-periodic parabolic problem $u_t = u_{xx}$. The three types of high order spatial schemes considered are (explicit) centered differencing, the super-convergent smooth spline-Galerkin schemes discovered by Thomée, and the very high order implicit schemes (Mehrstellenverfahren) which generalize Numerov's method. Seven time discretizations are introduced, namely Euler, backward-Euler, duFort-Frankel, 2nd order explicit, trapezoidal, Calahan-Zlámal, and 4th order Padé. The computational work necessary to solve each full discretization is minimized, for given error requirements, by balancing the number of intervals per wavelength against the number of time intervals per eth-life. The resulting data are used to compare the relative efficiency of these finite element and finite difference methods. Secondly, some corresponding results for the hyperbolic problem $u_t = u_x$ are briefly reviewed. Finally, as Numerov-trapezoidal differencing turns out to be almost optimal for the heat equation, a tridiagonal implicit difference formula which extends Numerov differencing to the general 2nd order linear differential operator in one space dimension is presented. The technique used in deriving this scheme inspires certain difference analogs of some finite element schemes. It also leads to a curious modification of the diamond difference scheme for $u_t = u_x$. This "alternating kite" scheme has $O(\Delta t^2 + \Delta x^3)$ truncation error with no more computational work than the diamond scheme itself. (auth)

35078 NOTE ON THE UNIFIED DIRAC–VON NEUMANN FORMULATION OF QUANTUM MECHANICS. Tjostheim, D. (NTNF/NORSAR, Kjeller, Norway). J. Math. Phys. (N. Y.); 16: No. 4, 766-767(Apr 1975).

It is demonstrated that the mathematical model of a rigged Hilbert space is ideally suited for obtaining a unified Dirac–von Neumann formulation of quantum mechanics. It is shown that the eigenbras of an observable A can be interpreted as weak derivatives of certain functionals associated with the resolution of identity E_u, $u\epsilon(-\infty, \infty)$, associated with A. (auth)

35079 VESTIGIAL EFFECTS OF SINGULAR POTENTIALS IN DIFFUSION THEORY AND QUANTUM MECHANICS. Ezawa, H. (Murray Hill, NJ); Klauder, J. R.; Shepp, L. A. J. Math. Phys. (N. Y.); 16: No. 4, 783-799(Apr 1975).

Repulsive singular potentials of the form $\lambda V(x) = \lambda|x-c|^{-\alpha}$, $\lambda > 0$, in the Feynman–Kac integral are studied as a function of α. For $\alpha > 2$ such potentials completely suppress the contribution to the integral from paths that reach the singularity, and thus, unavoidably, certain vestiges of the potential remain even after the coefficient $\lambda \downarrow 0$. For $2 \geq \alpha \geq 1$ careful definition by means of suitable counter terms at the point of singularity (similar in spirit to renormalization counter terms in field theory) can lead to complete elimination of effects of the potential as $\lambda \downarrow 0$. For $\alpha < 1$ no residual effects of the potential exist as $\lambda \downarrow 0$. In order to prove these results one relies on the theory of stochastic processes using, in particular, local time and stochastic differential equations. These results established for the Feynman–Kac integral conform with those known in the theory of differential equations. In fact, a variety of vestigial effects can arise from suitable choices of counter terms, and these correspond in a natural way to various self-adjoint extensions of the formal differential operator. (auth)

35080 SPACE–TIME SYMMETRIES AND NONUNITARY REPRESENTATIONS OF THE POINCARE SEMIGROUP: DESCRIPTION OF UNSTABLE PARTICLES. Comi, M. (Univ., Milan); Lanz, L.; Lugiato, L. A.; Ramella, G. J. Math. Phys. (N. Y.); 16: No. 4, 910-917(Apr 1975).

The use of nonunitary representations of the space-time symmetry group to describe physical systems, as, e.g., unstable particles is justified. It is shown that such a generalization of the standard theory of symmetries is possible inside the approach to quantum mechanics recently developed by Ludwig. The Poincaré semigroup turns out to be the fundamental symmetry group and only Lorentz transformations must be unitary. (auth)

35081 QUANTUM MECHANICS ON HOMOGENEOUS SPACES. Doebner, H. D. (International Centre for Theoretical Physics, Trieste, Italy); Tolar, J. J. Math. Phys. (N. Y.); 16: No. 4, 975-984(Apr 1975).

A complete description of quantum kinematics on a homogeneous G-space M is presented using imprimitivity systems for G based on M. The kinematics on M is considered (if possible and consistent with this quantization) as kinematics on a G-orbit equivalent to M in some Euclidean space R_n. This method gives a physically justified and mathematically well defined method of connecting the free Hamiltonian of a quantum system in R_n with an operator proportional to the Laplace–Beltrami operator on M (with the Riemannian structure inherited from R_n) which is proposed to be the free Hamiltonian on M. (auth)

Quantum Field Theories

Refer also to abstracts 34642, 34734, 34743, 34989, 35015, and 35113.

35082 FORMULATION OF THE LOW-ENERGY THEOREMS IN AN APPROACH WITHOUT INFRARED DIVERGENCES. Gerdzhikov, V.; Kulish, P. pp vp of Second National Conference of the Young Physicists. Sofia; Komitet za Mirno Izpolzuvane na Atomnata Energiya (1974). (In Bulgarian).

From 2nd national conference of the young physicists; Sofia, Bulgaria (10 Apr 1974).

The low-energy theorems studied link the scattering amplitude for charged particles with the amplitude of the same process, when an additional emission of soft quanta is present. Starting from a theory in which the photon possesses a mass $\lambda \neq 0$ and there exists a renormalized Feynman's S-matrix S_F, the infrared divergences are separated as a pair of operators v and v^+: $S_F = \int d^4y\, v(x)\, \hat{S}(x)\, v^+(x)$. The limit $\lambda \to 0$ does not lead to infrared divergences, the operators v(x) define the asymptotic state space and the coefficient functions of $\hat{S}(x)$ give the low-energy theorems. The latter are determined by the asymptotics of the amplitudes. (INIS)

35083 WARD IDENTITIES, THE RENORMALIZATION GROUP AND THE CALLAN–SYMANZIK EQUATION. Collins, J. C. (Univ. of Cambridge, Eng.). Nuovo Cim.; 25A: No. 1, 47-52(1 Jan 1975).

The Ward identity for broken scale invariance in n dimensions is shown to be the equation obtained by dimensional analysis. Renormalizing and taking the limit $n \to 4$ allows extraction of the anomaly at n = 4. This is found to give either the renormalization group equation or the Callan-Symanzik equation, depending on the renormalization prescription used. Thus, the identity of the two equations is manifest. (auth)

35084 RENORMALIZATION GROUP AND THE $g\varphi^4$-MODEL. Tirapegui, E. (Univ., Nice). Nuovo Cim.; 25A: No. 1, 75-90 (1 Jan 1975).

Renormalization group representations are given for the propagator and four-point vertex function of the $g\varphi^4$-model. The properties that are necessary for the existence of these representations in a global nonperturbative sense are stated precisely. Special attention is given to the invertibility postulate for the coupling constant which is explicitly discussed. It is remarked that in fact this property, as well as the renormalization group representations, just expresses the possibility of changing the parameters used to describe the theory (m^2 and g). The relation to the Callan-Symanzik equation is exhibited in view of a global discussion of the validity of this equation. An important case in which the global function $\beta(g)$ vanishes identically is pointed out. (auth)

35085 SINGULARITIES OF VACUUM DECAY AND REMARKS ON TACHYONS. Zel'dovich, Ya. B. (Inst. of Applied Mathematics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 20: No. 5, 151-152(5 Sep 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 20: No. 5, 338-341(5 Sep 1974).

The problem of the spontaneous decay of vacuum and tachyons are discussed disregarding cosmological considerations. A

complete analogy with the quantum states of a system is drawn. (JFP)

35086 DIAGRAMMAR. 't Hooft, G.; Veltman, M. (CERN, Geneva). pp 177-322 of Particle Interactions at Very High Energies. Part B. Speiser, D. (ed.). New York; Plenum Publishing Corp. (1974).

From 2nd summer institute on particle interactions at very high energies; Louvain, Belgium (12 Aug 1973). See CONF-730863-PB.

Quantum electrodynamics is used to discuss gauge theories. Among the topics treated are the Kallen-Lehmann representation, interim cut-off method: unitary regulators, cutting equations, unitarity, the indefinite metric, dressed propagators, canonical transformations, the electromagnetic field, combinatorial methods, and regularization and renormalization. (JFP)

35087 THE MASS GAP FOR THE $P\varphi_2$ QUANTUM FIELD MODEL WITH A STRONG EXTERNAL FIELD. Spencer, T. (New York Univ., N. Y. (USA). Courant Inst. of Mathematical Sciences). Commun. Math. Phys.; 39: No. 1, 63-76(Nov 1974). 14 refs.

The $P\varphi_2$ hamiltonian whose interaction density is given by $\lambda P\varphi(X) + \mu\varphi(X)^k$ where k is odd and $1 \leq k < {}^\circ P$ is considered. For sufficiently large μ it is shown that there is a gap in the energy spectrum. In addition new regions of analyticity in λ and μ for the Schwinger functions and the pressure are obtained. (auth)

35088 COMPOSITE FIELD THEORY AND VECTOR MESON DOMINANCE (VMD), PARTIAL CONSERVATION OF AXIAL VECTOR CURRENT (PCAV), FIELD-CURRENT IDENTITY, AND SOME PROBLEMS OF CURRENT ALGEBRA. Ho, T. H.; Huang, T. (Inst. of Atomic Energy, Peking). Tung Wu Hsueh Pao; 23: No. 6, 408-418(Nov 1974).

The theory of vector meson dominance, partial conservation of axial vector current, field-current identity and the combined algebra of field and current with the application of the composite field theory are derived. It can be shown that an unified theoretical foundation can be given by the composite field theory for these various theories. (auth)

35089 ASYMPTOTIC BEHAVIOUR OF SUPERSYMMETRIC YANG-MILLS THEORIES IN THE TWO-LOOP APPROXIMATION. Jones, D. R. T. (Sussex Univ., Brighton (UK). School of Mathematical and Physical Sciences). Nucl. Phys., B; 87: No. 1, 127-132(24 Feb 1975).

A calculation of the renormalization group function $\beta(g)$ to $0(g^5)$ for a supersymmetric Yang-Mills theory is presented. It is found that in no case do both the leading terms in the perturbation expansion of $\beta(g)$ vanish. (auth)

35090 PARTICLE PRODUCTION AT LARGE TRANSVERSE MOMENTUM. Halliday, I. G.; Huskins, J.; Sachrajda, C. T. (Imperial Coll. of Science and Technology, London (UK). Dept. of Physics). Nucl. Phys., B; 87: No. 1, 93-108(24 Feb 1975).

The production of large transverse momentum particles in massive electrodynamics is studied. The dominant final states at large energy are very different from those proposed in recent models. The large transverse momentum "trigger" particle is accompanied by other particles all of which have large transverse momentum. With the exception of the balancing particle these are uncorrelated in direction with the trigger. The magnitudes of their transverse momenta are ordered in exactly the same manner as longitudinal momenta are ordered in small transverse momentum collisions. At fixed $\chi_\perp = p_\perp/\sqrt{s}$ their longitudinal momenta are not ordered but become so as $\chi_\perp \to 0$. At infinite energies the average multiplicity, at fixed $\chi_\perp$, is given by $c(\log s)^{\chi_\perp}$. At $\chi_\perp \to 0$ it is given by c' log s. These results are contrasted with the partonlike results of ϕ^3. The multiplicity distribution is much narrower than Poisson. (auth)

35091 SHORT-DISTANCE ANALYSIS OF THE TRIANGLE ANOMALY IN QUANTUM ELECTRODYNAMICS. Crewther, R. J. (Eurpean Organization for Nuclear Research, Geneva (Switzerland)); Nielsen, N. K. (Aarhus Univ. (Denmark)). Nucl. Phys., B; 87: No. 1, 52-60(24 Feb 1975).

The connection between the existence of a non-zero triangle anomaly and the short distance properties of Green functions in quantum electrodynamics (QED) are reexamined. It is found that part of a previous analysis must be corrected, and some additional observations on the internal consistency of finite theories of QED are recorded. (auth)

35092 QUARK CONFINEMENT AND QUANTUM VORTEX STRINGS IN NAMBU-HEISENBERG MODEL. Tze, H. C.; Ezawa, Z. F. (Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics). Phys. Lett., B; 55: No. 1, 63-66(20 Jan 1975).

By way of the Boson method in superconductivity, interacting vortex strings are derived from a Nambu-Heisenberg quark-gluon field theory with an inhomogeneous vacuum. Quarks and gluons can be completely confined within Nambu strings seen as the dominant low energy manifestation of subhadronic interactions. (auth)

35093 CONFORMALLY COVARIANT FIELD EQUATIONS. I. First-Order Equations with Non-Vanishing Mass. Kotecky, R. (Charles Univ., Prague); Niederle, J. Czech. J. Phys.; B25: No. 2, 123-149(1975).

The connection of conformal fields with the Mackey theory is discussed. The necessary and sufficient conditions for the finite or infinite component field equation $(L_\mu \partial^\mu + m)\psi(x) = 0$ to be conformally covariant, are derived. The conditions are then explicitly solved under very general assumptions and thus conformally covariant equations of the above type are explicitly found. The circumstances under which the equation may be obtained from a Lagrangian are discussed. (auth)

35094 DESCRIPTION OF NON-POLYNOMIAL QUANTUM FIELD THEORIES BY SUPERPROPAGATOR METHOD. Volkov, M. K. (Joint Inst. for Nuclear Research, Dubna, USSR). Fortschr. Phys.; 22: No. 9, 499-523(1974).

The description of superpropagator method and its applications to the mesodynamics, weak interaction, electrodynamics involving gravity and the chiral invariant field theory is given. The low energy behavior of particles is described, taking into account the loop Feynman diagrams. The renormalizations of physical quantities are finite and are expressed in terms of coupling constants. (auth)

35095 SCATTERING MATRIX FOR SOME NON-POLYNOMIAL INTERACTIONS. I. Albeverio, S.; Hoeegh-Krohn, R. Institute of Mathematics Preprint Series, No. 9. Oslo; Univ. Oslo (1972). 47p.

Quantum field theoretical models in n dimensional space-time with interaction densities which are bounded functions of an ultraviolet cut-off boson field are studied. For the scattering matrix of the space cut-off interaction, constructed in terms of asymptotic fields, analyticity in the coupling constant λ and convergence of the linked cluster expansion for sufficiently small λ are proved. The correlation functions and imaginary-time Wightman functions for the infinite volume limit constructed previously are also proved to have a linked cluster expansion, convergent for sufficiently small values of λ. This is then used, together with the results on the space cut-off S-matrix, to establish the existence and analyticity in λ of the infinite volume scattering functions, and to prove reduction formulas for the infinite volume Wightman functions. (auth)

35096 LAGRANGIAN FOR PERFECT FLUIDS IN SPECIAL RELATIVITY. Cavalleri, G. (CISE, Milan); Spinelli, G. Nuovo Cim.; 25B: No. 1, 357-366(11 Jan 1975).

The requirement of linearity between forces and accelerations leads to a unique given form for the Lagrangian density, which is also useful to construct nonlinear gravitational theories with distributed matter. Taking into account the two constraints (1) $dx^\alpha dx_\alpha = ds^2$ and (2) the continuity equation, one obtains a unique (vector) variational equation which generalizes the Khalatnikov-Infeld equation which takes into account the constraint (1) only (and in turn generalizes the Euler-Lagrange equation). In this way one obtains the usual (vector) equation of motion for perfect fluids with no ambiguity. Besides, one reconfirms the validity of this equation in spite of recent criticisms. (auth)

35097 CONFORMAL INVARIANCE OF QUANTUM FIELDS IN TWO-DIMENSIONAL SPACE-TIME. Kupsch, J.; Ruehl, W.; Yunn, B. C. (Univ. Trier-Kaiserlautern, Ger.). Ann. Phys. (N. Y.); 89: No. 1, 115-148(Jan 1975).

Investigations of conformal invariance are based on the theory of analytic representations of the conformal group and its universal covering group. With its help the action of the conformal group on free massless fields, Greenberg fields, Wick products of these fields, and the Thirring fields is studied. In this context an infinite set of new operator solutions for the Thirring model that are all equivalent to each other. Explicit constructions of the nonlocal special conformal transformations of all these fields are given. (auth)

35098 REDEFINITIONS OF THE ENERGY MOMENTUM TENSOR. Villarroel, D. (Univ. Chile, Santiago). Ann. Phys. (N. Y.); 89: No. 1, 241-253(Jan 1975).

Some redefinitions of the energy-momentum tensor of classical electrodynamics are analyzed. Usually it was considered as a

necessary and sufficient criterion for redefining the energy-momentum tensor that the new tensor yields the "true" equation of motion of the electron, that is, the Lorentz–Dirac equation. It is shown that such a property is not sufficient. In fact, one studies two specific examples in which the redefined energy momentum tensor yields a Lorentz–Dirac equation. However, in both cases the corresponding rate of emission associated to them is different from the well known Larmor rate. (auth)

35099 DUALITY CONDITION FOR A HERMITIAN SCALAR FIELD. Bisognano, J. J. (Univ. of California, Berkeley); Wichmann, E. H. J. Math. Phys. (N. Y.); 16: No. 4, 985-1007(Apr 1975).

A general Hermitian scalar field, assumed to be an operator-valued tempered distribution, is considered. A theorem which relates certain complex Lorentz transformations to the TCP transformation is stated and proved. With reference to this theorem, duality conditions are considered, and it is shown that such conditions hold under various physically reasonable assumptions about the field. A theorem analogous to Borchers' theorem on relatively local fields is stated and proved. Local internal symmetries are discussed, and it is shown that any such symmetry commutes with the Poincaré group and with the TCP transformation. (auth)

35100 GENERALIZED FREE FIELDS AND THE REPRESENTATIONS OF WEYL GROUP. II. Reducible Representations. Lukierski, J. (Univ. of Wroclaw); Sienkiewicz, W. J. Math. Phys. (N. Y.); 16: No. 4, 901-904(Apr 1975).

The multiplets of generalized free fields, transforming according to triangle indecomposable representation of dilatation group are studied. Further, using the technique of Mellin transform, an arbitrary generalized free field is represented as a continuous superposition of fields with definite dimensionality. (auth)

35101 VECTOR AND TENSOR FIELDS ON CONFORMAL SPACE. Mayer, D. H. (Institut fuer Theoretische Physik, Aachen). J. Math. Phys. (N. Y.); 16: No. 4, 884-893(Apr 1975).

Vector and tensor fields on the compactified Minkowski space M_c^4 are considered, and their transformation properties are investigated under the group SO(2,4) of conformal transformations which are well defined on the manifold M_c^4 contrary to their singular behavior on the pseudo-Euclidean noncompact Minkowski space M_4. In writing down field equations on the manifold M_c^4, one gets immediately the well known conformal invariance of Maxwell's equations. Also the problem of gauge transformations of the vector potential is treated both from the global point of view on the manifold M_c^4 and from the local point of view on the Minkowski space M_4. There it is shown which gauge instead of the so-called Lorentz gauge one has to choose to get a conformal covariant formulation of Maxwell's equations on the pseudo-Euclidean noncompact Minkowski space M_4. (auth)

35102 MASSIVE VECTOR PARTICLES WITH YANG–MILLS COUPLINGS. Smit, J. Los Angeles; Univ. of California (1974). 293p. University Microfilms Order No. 75-9434.

Thesis (Ph. D.).

The massive Yang–Mills theory is investigated using source theory methods. The properties of gauge invariant source models and of gauge invariant Green functions are explored, which leads to an understanding of the high energy behavior of physical amplitudes. It is found that the one-loop approximation is unambiguous but that the two-loop approximation contains undetermined subtraction constants. A comparison is made with the quantum field theoretic description. The massless Yang–Mills theory is investigated for possible massive solutions, using crude approximations to the Schwinger–Dyson equations of quantum field theory. Results indicate that dynamical mass generation is possible. Compatibility with the Ward–Slavnov–Taylor–Lee ... identities is checked. (Diss. Abstr. Int., B)

Gravitation and General Relativity

Refer also to abstract 35101.

35103 GRAVITATION AND NONLINEAR SPINOR THEORY. Danilyuk, B. V. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 75-81(1974). (In Russian).

Within the framework of one model of the nonlinear spinor theory of matter an attempt was made to describe the gravitational interaction. It was shown that in the scattering amplitude of two primary fermions there is a contribution corresponding to one-graviton exchange. A relation was obtained between the gravitational constant and the mass of subparticles. (tr-auth)

35104 QUANTUM CORRECTIONS TO THE GRAVITON PROPAGATOR. Capper, D. M. (Imperial Coll. of Science and Tech., London). Nuovo Cim.; 25A: No. 1, 29-46(1 Jan 1975).

The lowest-order massive scalar loop corrections to the graviton propagator are evaluated using the technique of dimensional regularization. It is shown how to handle a particularly troublesome massive tadpole diagram by adding an appropriate cosmological counter-term. The quantum corrections are then in agreement with the Slavnov-Ward identities. The finite part can be extracted and the divergent part cancelled by suitable generally covariant counter-terms. An extensive comparison is made with previous calculations of the graviton, photon and neutrino one-loop corrections to the graviton propagator. The problem of renormalizability is also discussed. (auth)

35105 THEORY OF THE DOPPLER EFFECT IN THE GENERAL THEORY OF RELATIVITY. Shuster, G. V. (Donetsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 145(1974). (In Russian).

By use of the laws of conservation of matter in a space with random metrics $g_{ik}(x)$, the Doppler effect in the general theory of relativity is studied. (JSR)

35106 GRAVITATION AND COMPENSENTIVE FIELDS. Frolov, B. N.; Sardanashvili, G. A. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 9, 47-51(1974). (In Russian).

The compensentive approach to the theory of gravitation was examined. A general method of compensating fields for random Lie groups was discussed. Its geometric and physical interpretation was considered. In the special case of Lorentz groups a theory of gravitation was constructed. (tr-auth)

35107 INVARIANTS OF LOCAL LORENTZ SUBGROUP IN EINSTEIN'S THEORY OF GRAVITATION. Ivanitskaya, O. S. (Inst. of Physics, Minsk). Dokl. Akad. Nauk SSSR: 218: No. 3, 540-542(21 Sep 1974). (In Russian).

The relations of coordinate and local Lorentz transformations in the general theory of relativity are shown. The additive gauge conditions are derived. R invariants are considered. Chronometric and chrono-chorometric apparatus are considered. (JSR)

35108 GEOMETRICAL APPROACH TO A NEW UNIFIED FIELD THEORY. Ghosh, N. N. (Indian Association for the Cultivation of Science, Calcutta). India J. Phys.; 48: No. 8, 731-734(Aug 1974).

A nonsymmetric tensor $g_{\mu\nu}$ is defined by the 16 scalar products of two sets of tangent vectors $C_{,\mu}$, $D_{,\nu}$ at corresponding points of a pair of mutually conjugate 4-dimensional varieties V_1 and V_2. The symmetric part of $g_{\mu\nu}$ and the antisymmetric part of $g_{\mu\nu}$ are then identified with the gravitational metric tensor and the electromagnetic tensor, respectively. Taking the contravariant vectors $C^{,\mu}$, $D^{,\nu}$ associated to $C_{,\mu}$, $D_{,\nu}$ and the symmetric derivatives one can form 80 connection coefficients $\left\{ {C^{,\lambda} \atop D_{,\mu\nu}} \right\}$ and $\left\{ {D^{,\lambda} \atop C_{,\mu\nu}} \right\}$ symmetric in μ, ν. Imposing now the sixteen conditions $\left\{ {C^{,\lambda} \atop D_{,\mu\mu}} \right\} = \left\{ {D^{,\lambda} \atop C_{,\mu\mu}} \right\}$ (μ, not summed), one can formulate the new unified field theory. (auth)

35109 INTERPLANETARY RADAR TIME DELAY IN AN ARBITRARY THEORY OF GRAVITATION. Nuotio, V. S. (Academy of Finland, Helsinki). Celestial Mech.; 10: No. 4, 399-404 (Dec 1974).

Expressions for the interplanetary radar time delay in the one-body problem of an arbitrary gravitational theory are deduced. The structure of the theory enters the result through two functions of one variable, $f(t)$ and $q(t)$, always connected by an identity. (auth)

35110 LORENTZ VARIABLES PSEUDO-ISOTROPICALLY IMMERSED IN A MINKOWSKI SPACE. Rosca, R.; Rouxel, B.; Vanhecke, L. (Univ., Louvain, Belg.). Istanbul Univ. Fen Fak. Mecm., Seri A; 37: 23-34(1974). (In French).

The pseudo-isotropic Lorentz variables V_{ps} are studied. The V_{ps} of codimension 2 immersed in a Minkowski space are examined for the three following cases: the unique torsion form is zero, the unique torsion form is not zero, and the spatially mixed connection forms are all zero without the variable being totally geodesic. The immersion of V_{ps}^n in the Minkowski space M^{n+2} shows a 1-form ω completely integrable and a field of isotropic vectors I, which are found in the study of V_{ps}^2 immersed in M^{n+2}, which will be studied subsequently. (tr-auth)

35111 HOMOTHETIC MOTIONS AND PERFECT FLUID COSMOLOGIES. McIntosh, C. B. G. (Monash Univ., Clayton (Australia). Dept. of Mathematics). Phys. Lett., A; 50: No. 6, 429-430(13 Jan 1975).

A theorem on homothetic (self-similar) motions in spacetimes with a perfect fluid is derived. The main result is that a perfect fluid cosmological model cannot have a non-trivial homothetic motion orthogonal to the fluid 4-velocity vector. (auth)

35112 CHARGED TOMIMATSU–SATO METRICS. Das, K. C. (Department of Physics, Katwa College, Katwa, Burdwan, India); Banerji, S. (Burdwan Univ., West Bengal (India)). Phys. Lett., A; 50: No. 6, 409-410(13 Jan 1975).

It is shown that the solutions of Einstein–Maxwell field equations can be constructed from the Tomimatsu–Sato solutions of Einstein's field equations for empty space simply by inspection when δ has integral values. (auth)

35113 SPHERICALLY SYMMETRIC RIGOROUS SOLUTIONS IN BONNOR'S UNIFIED FIELD THEORY. Pant, D. N. (Banaras Hindu Univ., India). Nuovo Cim.; 25B: No. 1, 175-190(11 Jan 1975).

It is well known that the field equations in Einstein's unified field theory of 1953 do not lead to the Lorentz equations of motion for electromagnetic charges. Bonnor remedied this defect by proposing a modified set of the field equations. An attempt is made to solve Bonnor's field equations in the spherically symmetric case. The general solution of these equations in the magnetostatic case is obtained. It is found that when Bonnor's constant p is taken to be real, the solution becomes singular for two finite nonzero values of r analogous to the Reissner-Nordström solution in general relativity. On the other hand, when p is imaginary, the solution has a finite nontrivial singularity of Schwarzschild's type. The field equations were solved in the magnetic case also, though the solution in this case reduces to the corresponding static solution under the usual boundary conditions. Further, it is shown that Bonnor's theory does not favor the existence of a nonstatic spherically symmetric isolated system containing electric charge and current. (auth)

35114 GENERALIZED LAGRANGIAN FOR GENERAL RELATIVITY AND SOME OF ITS IMPLICATIONS. II. Kohler, M.; Goenner, H. (Univ., Goettingen, Ger.). Nuovo Cim.; 25B: No. 1, 308-314(11 Jan 1975).

The most general scalar Lagrangian density leading to Einstein's field equations contains two invariants F, K quadratic in the components of the curvature tensor. The Lagrangian $L = (-g)^{\frac{1}{2}} F$ is considered. The vanishing of the Lagrangian derivative leads to a set of identities and to a representation of $(-g)^{\frac{1}{2}} F$ as the divergence of a 4-component quantity. An expression for this quantity is determined which depends on the metric $g_{\alpha\beta}$ and its derivative only. The contribution of $L = (-g)^{\frac{1}{2}} F$ to the canonical energy-momentum complex is calculated. (auth)

35115 ROTATING SPHEROID AS A POSSIBLE SOURCE OF THE KERR METRIC. Florides, P. S. (Trinity Coll., Dublin), Nuovo Cim.; 25B: No. 1, 251-278(11 Jan 1975).

The gravitational field of a spheroid of small eccentricity ϵ, rotating steadily about its axis of symmetry, is calculated inside and outside the spheroid up to the order k^3 using the Florides-Synge method of successive approximations; k is a small dimensionless parameter of the order $(m/b)^{\frac{1}{2}}$ where m is the gravitational mass and b a typical radius of the spheroid. Assuming that the constants m and a appearing in the Kerr (exterior) metric are of the order k^2 and k, respectively, it is shown that the Kerr metric, up to the order k^3, is precisely the (exterior) field of the rotating spheroid. The eccentricity of the spheroid is directly related to the angular momentum a per unit mass of the spheroid. Since in the Florides-Synge method the field is calculated simultaneously inside and outside the spheroid, one automatically has an interior Kerr solution up to the order k^3. Arguments are put forward indicating that the spheroid cannot consist of perfect fluid. (auth)

35116 NULL DYNAMICS OF GENERAL RELATIVITY IN THE RAY GAUGE. Aragone, C.; Chela-Flores, J. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim.; 25B: No. 1, 225-241(11 Jan 1975).

The dynamics of general relativity is considered as the evolution of the field variables along a null-time coordinate. Starting from the first-order Palatini action, algebraic constraints are eliminated and differential constraints found after choice of the ray gauge condition $g_{1\nu} = 0$. The dynamical role of field components is analyzed. It is given the form of the unconstrained action and of the associated null energy J^u for the gauge $g_{uv} = -1$ in terms of only two dynamical variables, g_{ij}^T and Γ_{ju}^{iT}, the minimum number of variables expected for describing the dynamics of the self-interacting helicity 2-massless Einstein field. (auth)

35117 CLASSICAL GENERAL RELATIVITY DERIVED FROM QUANTUM GRAVITY. Boulware, D. G. (Univ. of Washington, Seattle); Deser, S. Ann. Phys. (N. Y.); 89: No. 1, 193-240 (Jan 1975).

The existence of long range macroscopic attractive forces between masses implies the existence of a mediating helicity ±2 particle in special relativistic quantum particle theory. It is shown that this fact alone, without assuming the existence of an underlying tensor field, uniquely determines the long wavelength structure of quantum gravitation to be that of Einstein's theory. This equivalence is shown by deriving, from the Ward identities associated with the graviton propagator, the tree graph structure of the graviton-graviton and graviton-matter interaction and establishing that the classical Einstein action is the generating functional. Some properties of closed loop effects are also exhibited. (auth)

35118 MASSLESS SPINNING TEST ARTICLES IN A GRAVITATIONAL FIELD. Mashhoon, B. (Princeton Univ., NJ). Ann. Phys. (N. Y.); 89: No. 1, 254-257(Jan 1975).

The classical equations of motion of a massless spinning test particle are derived as a limiting case of Mathisson-Papapetrou equations. It is shown that when a particular supplementary condition is assumed the particle follows a null geodesic and the spin is either parallel or antiparallel to the direction of motion. Moreover, the helicity is conserved in an orientable space-time. The equations of the propagation of the momentum vector and the spin tensor along the trajectory are given and further implications of the solution are discussed. (auth)

35119 SCALE-INVARIANT EQUATIONS OF GRAVITATIONAL FIELD IN THE THEORY WITH QUADRATIC LAGRANGIANS. Nikolaenko, V. M. (All-Union Scientific-Research Inst. of Physical-Technical and Radiotechnical Measurements, Moscow). Dokl. Akad. Nauk SSSR; 218: No. 5, 1068-1070(11 Oct 1974). (In Russian).

The gravitational theory with quadratic Lagrangians was studied extensively using variational methods to obtain the field equations. In the present study scale-invariant equations are obtained on the assumption that variations from the variables become zero at the boundary. The space examined is the differentiable manifold V_4 with Riemann coherence and Lorentz signature. (JSR)

35120 RADIATION DAMPING IN A GRAVITATIONAL FIELD. Beig, R. (Oesterreichischen Akademie der Wissenschaften, Vienna). Acta Phys. Austr.; 38: No. 3, 300-308(1973).

For a classical electron moving in an externally given gravitational field electromagnetic radiation reaction is rederived by a method due to THIRRING, adapted to curved Riemannian space-time. (auth)

35121 GRAVITATIONAL RADIATION FOR A SYSTEM OF TWO SPHERICALLY SYMMETRIC BODIES. Petrova, N. M.; Sandina, I. V. (Kazakh Pedagological Inst., Alma-Ata, USSR). Dokl. Akad. Nauk SSSR; 217: No. 2, 319-321(1974). (In Russian).

The equations of motion were found for a system of two spherically symmetric bodies in a harmonic system of coordinates by the Fok method of successive approximations. An expression was derived from these equations for the gravitational radiation of the system. (JSR)

35122 ELECTROSTATIC OR GRAVITATIONAL INTERACTION ENERGY OF COAXIAL ELLIPSOIDS. Schultheis, H. (Institut fuer Theoretische Physik, Tuebinen, Ger.); Schultheis, R. J. Math. Phys. (N. Y.); 16: No. 4, 905-909(Apr 1975).

An expression, which is appropriate for high precision calculations, is derived for the interaction energy of two coaxial ellipsoidal distributions of charge or mass. By starting from Dirichlet's expression for the potential it is shown that the (in general) sixfold integration can be considerably reduced by integrating over equipotential surfaces and introducing elliptic integrals. The evaluation of the final expression requires only a double numerical integration. (auth)

35123 NONSPREADING SOLUTIONS OF THE INHOMOGENEOUS SCALAR WAVE EQUATION. Couch, W. E. (Univ. of Calgary, Alberta); Torrence, R. J. J. Math. Phys. (N. Y.); 16: No. 4, 857-861(Apr 1975).

A simple condition that is necessary and sufficient for the solution of the inhomogeneous wave equation to be a nonspreading wave is derived for a class of driving terms that arise in certain physical problems. The condition is applied to the analysis of the self-scattering of gravitational multipole radiation at second perturbative order. It is proved that there is no scattering at the multipole component of highest order in the second-order gravitational field. It is conjectured that there is no scattering for every component of the second-order field. A mathematical expression of this conjecture, derived from the condition for

nonspreading, is given, and it implies conjectured identities on Clebsch–Gordan coefficients. (auth)

35124 NUT-LIKE GENERALIZATION OF AXISYMMETRIC GRAVITATIONAL FIELDS. Reina, C. (Univ., Milan); Treves, A. J. Math. Phys. (N. Y.); 16: No. 4, 834-835(Apr 1975).

The complex potential formulation of the axisymmetric problem discussed by Ernst enables one to construct new solutions from a given one, by multiplying the corresponding potential by a unit complex number. This rotation introduces naturally the NUT parameter in the metric. The generalized Kerr, Weyl, and Tomimatsu–Sato solutions are explicity constructed. (auth)

35125 BEHAVIOR OF THE N-PARTICLE SYSTEM IN THE DYNAMICS WITH RETARDATIONS AND IN THE POST-NEWTONIAN APPROXIMATION OF GENERAL RELATIVITY. Zhdanov, V. I.; Pyragas, K. A. (Inst. for Theoretical Physics, Kiev). Acta Phys. Pol.; B6: No. 1, 7-16(1975).

The conditions are given which guarantee a complete dispersion of the n-particle system in the dynamics with retardations. The theorems concerning the behavior of the n-particle system in the Post-Newtonian approximation are proved. (auth)

35126 "STRONG" AND "WEAK" GRAVITY: A GENERALLY COVARIANT CLASS OF MIXING MODELS OF SPIN-2 NEUTRAL FIELDS. Hammel, W. C. Jr. Milwaukee; Univ. of Wisconsin (1974). 254p. University Microfilms Order No. 75-9112. Thesis (Ph. D.).

The desirability of modifying Einstein's gravitational theory within small distances is discussed. A generally covariant class of Lagrangians is proposed to do this. The physical cause of the short range modification is expected to be the existence of a heavy spin-2 meson. General theorems concerning the existence of solutions of specified form are proved, and certain solutions are given explicitly. In particular all constant solutions are given some of which determine two cones. The mass and spin content of the linearized equations is partially analyzed, and a local exact spherically symmetric solution is given which modifies the Schwarzschild field only within the Schwarzschild surface $r = 2m$. It is proven that the two tensor fields need not possess the same isometry groups and an investigation of the consequences of a generalized Kerr-Schild Ansatz is begun. (Diss. Abstr. Int., B)

REACTOR TECHNOLOGY AND REGULATION

35127 STATUS OF THE ARTS ON REACTOR DIAGNOSTIC TECHNIQUES. Nippon Genshiryoku Gakkaishi; 15: No. 12, 792-808(Dec 1973). (In Japanese).

The diagnosis of the abnormality in nuclear reactors aims at the improvement of the safety and reliability of nuclear reactors and nuclear plants, by detecting and locating the abnormality in the nuclear reactors and the plants, estimating the causes of that abnormality and taking prompt action on that abnormality. In light water reactors, reactor noise analysis has been widely utilized. This method is applied at zero output to measure dynamic parameters. This is also applied at power output to get information on the dynamics of reactors. Diagnosis using the detection of reactivity change can be utilized. A thermometer at the outlet of a fuel subassembly can detect the temperature change of coolant to indicate an abnormality in fuel pins. The sound technique, which is used to detect the sound signals generated by the voids in coolant, can be also applied to the diagnosis. In sodium-cooled fast reactors, system diagnosis is performed by neutron flux monitoring, coolant flow rate measurements, and reactivity measurements. Local diagnosis, which is not performed in light water reactors, is also important, and many detecting systems are proposed and investigated. (JA)

35128 NUCLEAR DESALINATION. Tamura, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Nippon Genshiryoku Gakkaishi; 16: No. 4, 165-172(Apr 1974). (In Japanese).

Based on the report by a study group in the Ministry of International Trade and Industry on nuclear power and multi-purpose utilization and the literature on seawater desalination, the nuclear desalination of seawater is reviewed. As frequently indicated, Japan is not affluent in natural water so for future water resources it must also depend on desalination. To produce water on a large scale, a dual-purpose plant, i.e., power generation plus desalination, is advantageous rather than a plant solely for water. In this case, a nuclear power plant (LWR) is better fitted for the purpose of thermal utilization than a thermoelectric power plant. As the desalination process, two methods in particular, i.e., multi-stage flash distillation and multiple-use vacuum distillation, are available. It is necessary to develop the technology. In connecting a nuclear power plant and a desalinating facility, several types are conceivable; the optimal design must be worked out, depending on the purpose. Due caution must of course be given to the safety aspect, especially concerning radioactivity. (JA)

35129 ALL OUT EFFORTS NEEDED FOR FULL SCALE NUCLEAR DEVELOPMENT. JAIF Project Plan, 1974, Announced. At. Jap.; 18: No. 5, 10-15(May 1974).

In early 1973, Japan Atomic Industrial Forum (JAIF) started its study of internal reorganization and renovation. The conclusion reached was that JAIF must be the center for registering the concensus of public opinion representing various circles and strata on atomic power development and utilization. Atomic power has become a supreme essential in the production of energy for the survival of mankind. Taking this into consideration, JAIF has set out its project plan for FY 1974 covering six new priority projects. Major JAIF's project plans for 1974 as follows: 1.Promotion of development and utilization policy. 2.Promotion of policies for safety, environment preservation and sites. 3. Development of atomic industries. 4.Promotion of closer international cooperation. 5.Education and securing of men of ability for the development of atomic power. 6.Perfection of investigation and research. 7.Effective supply of information and data. (JA)

35130 20 YEARS OF NUCLEAR ENERGY DEVELOPMENT IN THE FEDERAL REPUBLIC OF GERMANY. Schmidt-Kuester, W. J. (Bundesministerium fuer Forschung und Technologie); Bonn (F. R. Germany). Abt. Energieforschung und - technologie); Popp, M. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany). Referat Grundsatz- und Planungsfragen). Atomwirt., Atomtech.; 20: No. 1, 18-23(Jan 1975). (In German).

The review of the development and the analysis of the present status shows on the one hand that the efforts in this field have been considerably underestimated in the beginning, on the other hand however, the development has been so effective that the gap of 10 to 15 years in the field of nuclear technology has been reduced in all important sectors. The energy deficit, which was foreseen in the beginning of nuclear energy development, gave the impulse to support this important field also in the Federal Republic of Germany by considerable public expenditures. The present status allows nuclear energy to cover a significant part of electricity demands: for 1985 an installed nuclear power plant capacity of 45,000 MW is considered to be necessary, while a capacity of 50,000 MW is considered to be desirable. Without nuclear energy a decrease in dependence on oil would not be possible. Some important presuppositions, however, are still to be fulfilled in order to realize preplanning of nuclear energy, as for example: shorter terms in construction and planning of nuclear power plants; organizing and personnel measures regarding experts, constructors, and operators; further development in the field of safety techniques; and the realization of a closed waste management system within the nuclear fuel cycle. (auth)

35131 INCREASED POWER PLANT EFFICIENCY BY NEW TECHNOLOGIES. Rajakovics, G. E. (Gebrueder Boehler und Co. A. G., Seibersdorf (Austria). Abt Kerntechnik und Sonder-Maschinenbau). Atomwirt., Atomtech.; 20: No. 1, 24-28(Jan 1975). (In German).

In constructing large-scale power plants, the costs of fuel, heat removal, and environmental protection will be of greater importance than previously. The only technical solution which positively influences all three cost factors is an increase of plant efficiency. For this, steam processes with gas turbine processes and with mediums other than water are taken into consideration. At higher system temperatures, only alkali metals are suitable, first of all cesium and potassium; cesium, however, may be excluded due to its price. The knowledge gained within the fast breeder development in the field of alkali metal technology and especially the appropriate development work for space flight may bring about the realization of a thermal power plant with an alkali metal-steam coupling process. Double and triple steam processes are considered. The calculations for the triple steam process lead to the conclusion that an economic new type of power plants can be developed, where a total efficiency of 50-60% could be obtained by suitable combination of steam processes of the mediums potassium, diphenyl, and water. (auth)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 35530, 35549, 35550, 35559, 35628, 35630, 35631, 35637, and 35641.

35132 (NEDO-10859) STEAM VENT CLEARING PHENOMENA AND STRUCTURAL RESPONSE OF THE BWR TORUS (MARK I CONTAINMENT). McCready, J. L.; McBride, M. G.; Krepps, J. G.; Moody, F. J.; Javid, A.; Strickland, E. L. (General Electric Co., San Jose, Calif. (USA). Atomic Products Equipment Dept.). Apr 1973. 252p. General Electric Co., San Jose, CA.

The test program was developed to provide data necessary to confirm and adjust theoretical models of the pressure forces and torus structural responses resulting from the opening of a vent relief valve. Measurement locations were selected based upon prior theoretical models and actual experience as observed during relief valve discharges. The measurement devices consisted of displacement gages, and pressure sensors connected via appropriate signal-conditioning equipment to recorders. Various relief valve combinations were opened with the reactor operating at normal operational pressures and data from the sensors were recorded. The test program was developed by the General Electric Co.; instrumentation was installed in the torus at Quad Cities Unit 2. The plant was operated in specified modes for the test and data were recorded. A description of the Testing Operations is included. Results are presented. (auth)

35133 (TID-8200(R31)) NUCLEAR REACTORS BUILT, BEING BUILT, OR PLANNED. (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). 31 Dec 1974. 48p. Dep. NTIS $4.00.

Information is tabulated on nuclear reactor and critical assembly facilities in operation, shutdown, under construction, or planned. Data are included on name, location, type, power, and startup date. (DCC)

35134 THE GRABEN NUCLEAR POWER STATION. Bull. Schweiz. Elektrotech. Ver.; 65: No. 14, 1061-1065(13 Jul 1974). (In German).

The Bernische Kraftwerke Co (BKW) plans to construct a nuclear power station comprising two units each of 1140 MW net rating at Graben on the Aar in Switzerland. The site was approved in October 1972 and, pending the authority to proceed with the construction from the Swiss Federal and Cantonal Governments, a declaration of intent was signed in April 1974 with the Brown

Boveri/General Electric of America (BBC/GETSCO) consortium for the first unit due to incorporate a boiling water reactor of the new type BWR6/Mark II. (INIS)

35135 CONSTRUCTION OF FUKUSHIMA NUCLEAR POWER STATION UNIT NO. 3. Nomura, A.; Tanaka, H.; Shirasaka, Y. (Tokyo Electric Power Co. Inc. (Japan)). Konkurito Janaru; 12: No. 6, 72-81(Jun 1974). (In Japanese).

Construction works of buildings are nearly complete for the unit No. 3 of the Fukushima Nuclear Power Station. It employs a BWR with the electric output of 784 MW, built wholly by domestic technology. The construction works of main buildings, i.e., those for reactor, turbine, control, etc., are described as follows: outline of building structures; earthwork, concrete Caggregate, cement, etc., reinforcement, form works, and filling beneath a dry well; and standardization and prefabrication of building concrete-members for future construction. (JA)

35136 OPERATING PERFORMANCE OF CHARCOAL ADSORBER SYSTEM APPLIED IN BWR. Saito, R.; Shimozato, A.; Takeshima, M.; Saito, T. (Hitachi Ltd., Ibaraki (Japan). Hitachi Works); Yusa, H. Hitachi Hyoron; 23: No. 1, 2-7(Jan 1974).

The charcoal adsorber system applied in boiling water reactors (BWR), developed by Hitachi after three years of research for the prototype advanced thermal reactor "Fugen" under commission of the Power Reactor and Nuclear Fuel Development Corporation, has fully demonstrated its usefulness through practical utilization at Tsuruga and Fukushima nuclear power stations. It has thus been established that adoption of this system will markedly reduce the radioactivity of stack gas and will also serve as an effective means of environmental preservation, for which more serious regulations are expected. (auth)

35137 HEAT TRANSFER IN THE GAP BETWEEN FUEL AND CLADDING IN LWRs. Brzoska, B.; Wunderlich, F. (Kraftwerk Union A. G., Erlangen (F. R. Germany)). pp 330-333 of Reactor conference, Nuernberg 8.4-11.4.1975. Section 2: Fuel Elements, Fuel Cycle and Isotope Technique. Leopoldshafen, F. R. Germany; ZAED (1975). (In German)

From reactor conference; Nuernberg, F. R. Germany (8 Apr 1975). 4 figs.; 1 tab.

Experiments have been analyzed to obtain quantitative information on the mechanism of fuel-to-can gap closing, i.e., cracking and bursting of fuel pellets (relocation). (GE)

35138 SURFACE TREATMENT OF CORROSION RESISTANT COMPONENTS FOR BOILING WATER REACTORS. Weingerl, H.; Diebold, A. (Gebrueder Boehler und Co. A. G., Kapfenberg (Austria)). pp 619-622 of Reactor Conference, Nuernberg 8.4-11.4.1975. Section 3: Design, Construction and Operation of Nuclear Power Plants and Their Components. Leopoldshafen, F. R.,Germany; ZAED (1975). (In German)

From reactor conference; Nuernberg, F. R. Germany (8 Apr 1975). 5 figs.

Investigations were made on Nb-stabilized CrNi-steel W.No. 1.4550 for the determination of time-dependent corrosion behavior, stress corrosion cracking in boiling, 42% $MgCl_2$-solution, dependence on potential of the corrosion rate and polarization behavior during pickling, loss of weight as a function of pickling time, and cleansing effect of pickling solutions. The results of the surface analyses are given and discussed. (GE)

35139 STANDARD REFUELLING ELEMENTS FOR BWRs. Dyck, H. P.; Pohl, P. (Kraftwerk Union A. G., Frankfurt am Main (F. R. Germany)). pp 334-337 of Reactor Conference, Nuernberg 8.4.-11.4.1975. Section 2: Fuel Elements, Fuel Cycle and Isotope Technique. Leopoldshafen, F. R. Germany; ZAED (1975). (In German)

From reactor conference; Nuernberg, F. R. Germany (8 Apr 1975). 3 figs.

A description is given of standard fuel elements designed for BWRs in order to expedite future licensing procedures, simplify quality assurance measures, and assure replaceability of elements. (GE)

35140 OUTLINE OF ATOMIC POWER REACTOR OPERATOR TRAINING CENTERS IN JAPAN. Maesawa, Y. (Atomic Power Reactor Operator Training Center, Tsuruga, Fukui (Japan)); Matsuda, J.; Fujie, H. Nippon Genshiryoku Gakkaishi; 16: No. 4, 173-180(Apr 1974). (In Japanese).

With the rapid growth of nuclear power generation in Japan, it has become necessary to train many operators for nuclear power plants. Training of operating personnel was carried out by sending them to the United States. It is both inconvenient and costly, however. To meet the needs, two nuclear power plant operator training centers for PWRs and BWRs, respectively, were established in June 1972 and April 1974. The former has three courses, i.e. initial training, re-training (advanced) and general education; and the latter has two, initial and re-training. Training curricula, facilities, etc. of the two training centers are described. (JA)

35141 REGULAR INSPECTION OF A NUCLEAR POWER PLANT AND RADIATION CONTROL. Ota, M.; Miyake, T. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Haikan Gijutsu; 16: No. 7, 155-163(Jun 1974). (In Japanese).

In Japan, nuclear power generation based on LWR's is proceeding at a rapid rate. To maintain or better the reliability and operational safety of a nuclear power plant, regular inspection is carried out once a year during its service life by shutting down operation for an extended period. Regular inspection, on a BWR type nuclear power plant is described from the standpoint of its manufacturer, concerning regular inspection, the radiation control involved, and personnel radiation-exposure control. (JA)

35142 INSERVICE INSPECTION OF NUCLEAR REACTORS IN THE FEDERAL REPUBLIC OF GERMANY. Schaeufl, A. (Maschinenfabrik Augsburg-Nuernberg (M.A.N.) A. G., Nuernberg (F. R. Germany)). Nucl. Eng. Int.; 19: No. 222, 931-934(Nov 1974).

35143 TARAPUR ATOMIC POWER STATION: AN OFFICIAL VIEW OF ITS PERFORMANCE. Sci. Opin. 3: No. 1, 10-16(Aug 1974).

Information regarding the commissioning and functioning of the Tarapur Atomic Power Station (TAPS), India, is presented in the form of questions and answers. Topics discussed include the contract with GEC, the cost of the station, the performance of the reactor units 1 and 2 during 1970-74, fuel management, and future plans. (INIS)

35144 RECURRENT TESTS IN NUCLEAR POWER STATIONS WITH LIGHT WATER REACTORS. Ellmer, M. (Versuchsatomkraftwerk G.m.b.H., Kahl/Main (F. R. Germany)). VGB Kraftwerkstechnik; 54: No. 12, 807-810(Dec 1974). (In German).

Experience from operation must be fed into recurrent tests, if complete information is desired and if the necessary fault analyses are to be evaluated in respect of the evidence of the tests. This practice demonstrates the need to develop the test procedure continuously, in order to be able to assess the latest fault which is important from the technical safety point of view. (auth)

35145 AUTOMATIC REPAIR WELDING ON A NOT ACCESSIBLE SPOT IN THE REACTOR PRESSURE VESSEL. Guettler, R.; Meyer, W. pp 283-287 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

Problems, criteria, and applications are discussed for remote-control welding installations for repair of the reactor pressure vessels and the connecting pieces of the control rods of the VAK. The welding installation and the method used are described in detail. (JSR)

35146 FUEL ELEMENT. Morishima, A.; Mino, H.; Wakasugi, K. (to Japan Atomic Energy Research Inst., Tokyo). Japanese Patent 1973-23237/B/. 13 Sep 1967. 4p. (In Japanese).

The purpose of this invention is to provide fuel elements which can be easily assembled. A plurality of nuclear fuel rods is arranged at about equal distances so that the upper and lower ends of the fuel rods are fixed with a tie plate and a base plate. The circumference is surrounded by a passage section. The fixed parts are mounted on the outer side of a spacer, and either a tie plate or a base plate by means of of a connection piece connecting the fixed parts with nonrigid material. Thus the spacer is fixed with the tie plate and the base plate to fit in a pipe and constitutes the reactor fuel element. The nonrigidity of connecting parts allows the spacer to be easily positioned and also allows the fuel elements to be easily assembled. (JA)

35147 REACTOR POWER PLANTS. Kalide, W. pp 101-114 of Power Plants and Power Economy. Muenchen, F. R. Germany; Hanser (1974). (In German).

The physics of reactors is described in a brief summary. The nuclear reactions and the energy balances are given in examples of the functioning of today's nuclear power plants. Power reactors are judged according to their different construction and future chances of development. (GE)

35148 EXPERIENCE WITH ULTRASONIC TESTING OF NUCLEAR REACTOR PRESSURE VESSELS. Rath, W. (Krautkraemer (Dr. J. u. H.) Gesellschaft fuer Elektrophysik, Koeln (F. R. Germany)). Kerntechnik; 16: No. 12, 538-542(Dec 1974). (In German, English).

The ultrasonic recurrent testing of pressure vessels for water-cooled nuclear reactors is described. The advantages and disadvantages of early standardization are discussed and the situation in respect of codes in this field in the USA is compared with that in the FRG. The development of suitable testing equipment is discussed with reference to some reactor pressure vessel inspections already carried out. (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 35133, 35137, 35140, 35142, 35144, 35147, 35148, 35524, 35530, 35531, 35545, 35556, 35559, 35626, 35627, 35629, 35632, 35635, 35636, 35638, 35639, and 35641.

35149 (CONF-750303-36) STUDY OF THE $^{233}U-^{232}Th$ REACTOR AS A BURNER FOR ACTINIDE WASTES. Raman, S.; Nestor, C. W. Jr.; Dabbs, J. W. T. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 2p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

A plausible method for reducing the storage problems and hazards now associated with long-lived actinide wastes might be to recycle and convert these to fission products. Several reactor types can be envisaged for this purpose. In a $^{233}U-^{232}Th$ reactor, the production of ^{237}Np, Pu and transplutonium isotopes is greatly reduced compared to a $^{235}U-^{238}U$ reactor because several additional neutron captures are required to reach the same mass. Hence, the $^{233}U-^{232}Th$ reactor can be employed to effectively reduce Np, Pu, Am, and Cm wastes to fission-product wastes which entail shorter (≈1000 yr) storage times. (auth)

35150 (WCAP-7956) THINC-IV: AN IMPROVED PROGRAM FOR THERMAL-HYDRAULIC ANALYSIS OF ROD BUNDLE CORES. Chelemer, H.; Chu, P. T.; Hochreiter, L. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Jun 1973. vp. Westinghouse Electric Corp., Pittsburgh.

THINC-IV is a three-dimensional thermal hydraulic computer program which calculates the local coolant density, mass velocity, enthalpy, vapor void, static pressure, and the resulting DNBR distribution in a pressurized water reactor core. THINC-IV differs from other thermal-hydraulic programs in that lateral momentum equations including both inertial and frictional effects are incorporated into its solution scheme. All three momentum equations are included in the THINC-IV calculational procedure and are solved by employing a perturbation technique. Comparisons with experimental data have verified the calculation method and show that THINC-IV will correctly predict the thermal hydraulic behavior of a pressurized water reactor core. (28 references) (auth)

35151 CONSTRUCTION OF IKATA NUCLEAR POWER STATION. Nonaka, H. (Shikoku Electric Power Co., Ltd., Takamatsu, Kagawa (Japan)). Karyoku Genshiryoku Hatsuden; 25: No. 1, 21-30(Jan 1974). (In Japanese).

As the first nuclear power station of Shikoku Electric Power Company, the construction of Ikata nuclear power station is proceeding, with completion expected in April 1977. Situated on a peninsula of Ehime Prefecture, the power plant adopts a PWR with electric output of 565 MW. The following are described: siting; facilities including a reactor, a turbine, a sea-water desalination device, a waste disposal facility and electrical installation; power station layout; construction works; and preservation of environment. (JA)

35152 CONSTRUCTION OF TAKAHAMA NUCLEAR POWER STATION UNIT NO. 1 AND NO. 2. Ono, T.; Terada, J.; Ogaki, Y. (Kansai Electric Power Co. Inc., Osaka (Japan)). Konkurito Janaru; 12: No. 6, 82-92(Jun 1974). (In Japanese).

Construction was started in 1969, and is proceeding on units No. 1 and 2 of the Takahama Nuclear Power Station (both PWRs with output of 826 MW(e) each). Construction works of main buildings, i.e. those for reactor, turbine, etc., which are now nearly complete, are described as follows: topographical and geological investigation of site; plant layout; the structures of buildings; aseismatic design of the buildings; features and critical path of the construction works; and concrete works, including batch mixer, quality control of reinforced concrete, concrete laying within a reactor containment vessel, and the usage of prepacked concrete. (JA)

35153 OPERATIONAL RESULTS OF STEAM GENERATORS IN THE NUCLEAR POWER PLANT OCONEE-1. McDonald, B. N.; Scearce, J. S. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Development Center); Michaud, E. R. (Babcock and Wilcox Co., Alliance, Ohio (USA). Research Center). Atomwirt., Atomtech.; 19: No. 12, 597-601(Dec 1974). (In German).

10 figs.; 2 tabs.

The first nuclear steam generator of Babcock and Wilcox Co. utilizing the once-through system has performed successfully in the Oconee nuclear power plant. The evaluation and comparison of data on the steam generator showed good operational behavior. At full load the steam generator produces steam with 33°C superheating, thus considerably exceeding the guaranteed minimum superheating of 19°C. In all load points the measured steam temperatures correspond to the calculated operational behavior. The heating of feedwater by direct contact proved to be self-regulating. In less than 1.8 m the incoming feedwater reaches the local saturation temperature in the feedwater preheating area during the mixing with bleeder steam from the tube assembly. The quantity being revolved by natural rotation in case of the breakdown of all main cooling pumps highly exceeds the quantity necessary for heat removal. The steam generator shows a fast load cycle behavior and a good control behavior even under unusual load conditions. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 35133, 35147, 35522, 35529, 35535, 35633, and 35634.

35154 (GA-A-13168) STRONTIUM TRANSPORT DATA FOR HTGR SYSTEMS. Myers, B. F.; Bell, W. E. (General Atomic Co., San Diego, Calif. (USA)). 6 Dec 1974. Contract AT(04-3)-167. 73p. (GA-LTR-16). Dep. NTIS $6.75.

Strontium transport data applicable to HTGR systems are assembled and discussed; reference values have been derived from the available data and are presented in the form of equations and parameters suitable for use as input for reactor calculations. The reference data presented cover the following processes: (1) the diffusion of strontium in fuel kernels and in pyrocarbon, (2) sorption of strontium in fuel rod matrix material, (3) sorption of strontium in graphite, and (4) diffusion of strontium in graphite. (60 references) (auth)

35155 (LA-tr-75-9) PRELUDE-2: SEISMIC RESPONSE ANALYSIS CODE FOR BLOCK-TYPE FUEL CORE. Ikushima, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). Mar 1975. Translation of JAERI-M-5560. 74p. Dep. NTIS $6.75.

A computer code has been programmed for the seismic response of block-type fuel core of an atomic reactor. This code, PRELUDE-2, has the following features: discontinuous multi-point mass system; two dimensional system; applicability to any seismic wave; changeable time intervals for calculation, plotting and printing, thus reducing computer time without losing accuracy; and incorporation of subroutines for graphic representations of the results. Sample calculations are given. (auth)

35156 EXPERIMENT ON PRESTRESSED CONCRETE PRESSURE VESSEL FOR NUCLEAR REACTOR. Onishi, S. (Electric Power Development Co. Ltd., Tokyo (Japan)); Hisatomi, H. Konkurito Janaru; 12: No. 6, 37-46(Jun 1974). (In Japanese).

Experiment on the prestressed concrete pressure vessel for a gas cooled reactor has been made with the 1/10 linear scale model of the PCRV for Hinkley Point B power station in the U. K. The pressure ranges studied are (1) elastic range up to design pressure of 43 kg/cm^2 and (2) ultimate pressure up to rupture beyond the design pressure. The purpose is to compare between the stress analyzed by finite-element method and that of the experiment, to clarify the problems in construction, to confirm the safety of PCRVs and to observe PCRV rupture mode. (1) Prestressing by helical winding is effective both horizontally and vertically. (2) In the vicinity of the design pressure, the behavior of the PCRV is linear, being within elastic region. (3) The ultimate pressure is 3.0 times as high as the design pressure. (4) With increasing internal pressure, the sufficient plastic deformation of the PCRV occurred. (5) The results are in good agreement in the analysis by finite-element method and the experiment. As seen in the above results, the model experiment represents well the behavior of PCRVs; and PCRVs demonstrate sufficient safety for reactor use. (JA)

35157 DESIGN OF A STEAM REFORMER FOR USE IN THE PRIMARY LOOP OF A HIGH-TEMPERATURE REACTOR. Niemeyer, W. (Gesellschaft fuer Hochtemperaturreaktor-Technik m.b.H., Bensberg (F. R. Germany)). pp 761-763 of Reactor Conference, Nuernberg 8.4.-11.4.1975. Section 4: Reactor Concepts and Economics. Leopoldshafen, F. R. Germany; ZAED (1975). (In German)

From reactor conference; Nuernberg, F. R. Germany (8 Apr 1975). 1 fig.; 1 ref.

A steam reformer to be used in the primary loop of a HTR is described. The principle, the catalytic system, material problems, and the influence of contamination on the concept of operation, repair, and replacement are discussed. (GE)

35158 THE PRESENT STATUS OF DEVELOPMENT OF A MULTIPURPOSE HIGH-TEMPERATURE GAS COOLED REACTOR. Tokyo, Japan; Japan Atomic Energy Research Inst. (1974). 78p. (In Japanese).

In JAERI, research and development is in progress for a multi-purpose high-temperature gas cooled reactor, especially an experimental one for the near future, in compliance with the needs for the type of reactor system. Activities in this field for the past year are described in the following chapters: coated fuel-particle fuel, graphite material, heat-resisting metallic materials, reactor physics and engineering including instrumentation and high-temperature structural strength, heat transfer, in-pile gas loop (OGL-1), and design study. (JA)

35159 SHUT-DOWN PROCEDURES IN THE AVR HIGH-TEMPERATURE REACTOR. Knuefer, H. (Arbeitsgemeinschaft Versuchs-Reaktor G.m.b.H., Juelich (F. R. Germany)). Brennst.-Waerme-Kraft; 26: No. 12, 495-502(Dec 1974). (In German).

The shut-down procedure in nuclear power stations is of great importance in safety engineering. In the AVR high-temperature reactor, various shut-down possibilities were tested. After dealing with the measuring points and the arrangements in the secondary cycle, various shut-down procedures are described, such as scram, bringing-in of the shut-down rods, and shut-down of the cooling fans. The short, middle, and long-term behavior during shut-down is discussed, and diagrams are presented showing the changes of the most important characteristics during the shut-down procedures. (auth)

35160 NUCLEAR ENERGY AND SECONDARY ENERGY CARRIERS. Schulten, R.; Kugeler, K.; Barnert, H. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Energiewirt. Tagesfragen; 24: No. 12, 602-606(Dec 1974). (In German).

A brief survey is given of the energy market in the FRG where the energy costs are primarily dealt with. Furthermore, an explanation of the following concepts for nuclear energy supply is given: high temperature reactors to generate current, nuclear coal gasification, nuclear remote energy and nuclear water fission. Finally, a review is given of the present state of development of high temperature reactors in the FRG. (GE)

Power Reactors, Non-Breeding, Otherwise Moderated

35161 (GERHTR-89) DETERMINATION OF THE RESIDUAL FISSION METAL CONTENT AND BURNUP ON SPHERICAL FUEL ELEMENTS WITH A URANIUM-THORIUM HEAVY METAL INSERT BY THE GAMMA-SPECTROMETRIC ANALYSIS OF PROTACTINIUM-233 AND BARIUM-140. Duwe, R. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktonwerkstoffe und Heisse Zellen). May 1974. Translation of JUL-955-RW. 91p. Dep. NTIS $5.45.

Work performed under United States-German High Temperature Reactor Research Exchange Program.

The design of the AVR and the THTR pebble-bed reactor makes provision for a continual circulation of the reactor core. Previously used and fresh fuel elements are fed in to the core surface centrally or at the edge according to the required fuel concentration distribution and after passing through the core removed at the pebble removal pipe. After removal the individual fuel element can be checked for its reusability. For this purpose a knowledge of the particular burnup state and the fission metal content still present is particularly important, in order to separate out fuel elements which have reached their maximum burnup or to reintroduce into the core those which still contain sufficient fission metal. 24 references. (auth)

35162 NARORA ATOMIC POWER PROJECT HERALDS SELF-RELIANCE IN NUCLEAR TECHNOLOGY. Eng. Times (Calcutta); No. 405, 13-14(31 Jan 1974).

The salient features of the proposed Narora Atomic Power Station are described. The site of the station is located in the sparsely populated area on the right bank of the river Ganga, 5 km from the Narora barrage in the western part of Uttar Pradesh. The station will consist of two reactors of CANDU type, each of 220 MWe generating capacity. Though basically similar to the reactors of the Rajasthan Atomic Power Station and the Madras Atomic Power Station, the design of the Narora reactors has been modified to suit (1) the seismic conditions of the site due to the proximity of the Moradabad fault and (2) the alluvial foundation conditions. The design also incorporates the concept of double containment to minimise leakage of radioactivity to the environment in the event of the major reactor accident. The reactor buildings will be cylindrical in shape and will be connected through air-locks to the turbine building and the service building. Slightly radioactive gases will be discharged through the stack. Cooling water for condensers will be drawn from the lower Ganga canal. An integral end shield calandria assembly, instead of separately suspended calandria, will be used to prevent misalignment of the coolant channels in the event of a seismic occurrence. The indigenous content of the station such as the equipment, reactor components etc. will be 85%. The total cost estimated is Rs. 230/-crores (i.e. Rs. 2300 millions) with a foreign exchange of about Rs. 30/-crores (i.e. Rs. 300 millions). The first unit of the station is scheduled to achieve criticality by mid-1981 and the second in 1982. The electric power generated will be fed into the power systems of a number of states in the northern region of India. (INIS)

35163 CONSTRUCTION OF ADVANCED THERMAL REACTOR POWER PLANT. Kawada, T. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). Karyoku Hatsuden; 25: No. 4, 323-336(Apr 1974). (In Japanese).

Japan Power Reactor and Nuclear Fuel Development Corp. has been developing an advanced thermal reactor, which is a heavy water moderated, boiling light water cooled type reactor. Centering around the construction of this reactor "FUGEN", many associated fields such as nuclear-thermal design, machines and instrumentations, fuel materials and safety techniques are being studied and developed. This reactor is under construction in Tsuruga city in Fukui prefecture and is scheduled to reach criticality in 1976 and to develop rated electric power of 165 MW. This advanced thermal reactor works according to a plutonium self-sustaining cycle, which extracts plutonium from spent fuel and enriches it to natural uranium, and is loaded with this plutonium-enriched uranium. The use of plutonium as fuel brings the void coefficient of the coolant to the negative side. In the advanced thermal reactor, neutron economy is better, and the conversion rate is higher than light water reactors, so that the necessary consumption of natural uranium is half that of light water reactors. The reactor core consists of a carandria tank, pressure pipes, fuel and shielding. The carandria tank is filled up with heavy water and contains many pressure pipes. In each pressure pipe, a fuel assembly is inserted. Fuel exchange is performed from the bottom of core. (auth)

Power Reactors, Breeding

Refer also to abstracts 32827, 33810, 33903, 35133, 35147, 35205, 35523, 35525-35528, 35539, 35582, and 35583.

35164 (AI-AEC-13142) FUELS, MATERIALS, AND CONTROL ROD DEVELOPMENT PROGRAMS. Quarterly Technical Progress Report, October-December 1974. (Atomics International Div., Canoga Park, Calif. (USA)). 1974. Contract AT(04-3)-824. 31p. AT.

Progress is reported in the following areas: irradiation damage in cladding and core structural materials; helium generation in reactor materials; and control absorber heating experiments and calculations. (DCC)

35165 (AI-AEC-13145) DESIGN GUIDE FOR REACTOR COVER GAS ELASTOMERIC SEALS. Kurzeka, W. J.; Welch, F. H. (Atomics International Div., Canoga Park, Calif. (USA)). 7 Mar 1975. Contract AT(04-3)-824. 108p. AT.

This Design Guide for reactor cover gas elastomeric seals provides information for selection of seal geometries, materials, lubricants, and gland geometries plus information for estimating seal life and reactor gas permeation through seals. It is based on data accumulated under the LMFBR Cover Gas Seals Development Program sponsored by the AEC under Contract AT(04-3)-824. (6 references) (auth)

35166 (ANL-CT-75-33) DYNAMIC TRANSIENT ANALYSIS OF RUPTURE DISKS. Hsieh, B. J. (Argonne National Lab., Ill. (USA)). Feb 1975. 80p. Dep. NTIS $7.00.

A finite element method utilizing the principle of virtual work in "convected coordinates" is used to analyze the axisymmetric dynamic transient response of rupture disks. This method can treat non-linearities arising both from inelastic material properties and large displacements/rotations provided, that the convected strains are small. In convected coordinates, the deformation displacements are separated from the total displacements. Hence the strain calculations, constitutive laws and the computing of internal forces become much simpler. Furthermore, since the shape func-

tions are expressed in terms of the convected coordinates, they can represent the motion of the structure more realistically. Extensive calculations are presented using a variety of rupture disk geometries. The static buckling of such disks is related to their dynamic response characteristics. A majority of the calculations treat the response of 18 inch disks typical of those currently considered for use in the Clinch River Breeder Reactor intermediate heat transport system. 11 references. (auth)

35167 (ANL-Trans-977) FIRST IRRADIATION EXPERIMENT WITH CARBIDE FUEL ELEMENTS WITH A SODIUM BOND IN RAPSODIE (CAMILLE EXPERIMENT). Mikailoff, H.; Clottes, G. Translated from Bull. Inform. Sci. Tech. (Paris); 196: 41-48(Oct 1974). 12p. Dep. NTIS $4.00.

The results are presented for "carbide" type fuel elements irradiated in Rapsodie in 1969 and 1970, as a complete assembly of 19 pins. This assembly functioned at a maximum linear power of 800 W/cm, a 660°C cladding temperature and reached a specific burn-up of 27,000 MWd/t. The results of the examinations made after irradiation gave a certain number of values, particularly the swelling of the fuels and the fission gas discharge rate. Despite slight carburization of the claddings and some anomalies in the functioning of the sodium seal giving rise to hot spots inside the fuels, the pins performed in a completely satisfactory manner; no deformed or burst claddings. Among the four materials tested (UPuC, UPu C Mo, UPu CN and UPu N), the UPu C Mocarbide alloy gave the least satisfactory performance under irradiation; there was no appreciable difference between the three other fuels. (8 references) (auth)

35168 (ANL-Trans-978) CALCULATIONS OF THE CHARACTERISTICS OF "STANDARD" FAST REACTOR. Abagyan, L. L. P.; Baryba, M. A.; Petrova, L. V.; Savos'kin, M. M. (Gosudarstvenny) Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1974. Translation of FEI-525. 13p. Dep. NTIS $4.00.

The results of a new model calculation of a "standard" fast breeder reactor with PuO_2–UO_2 fuel and liquid sodium coolant are presented. 9 references. (DCC)

35169 (CEA-CONF-2898) CARBIDE VENTED FUEL ELEMENT: THEORETICAL STUDY OF RELEASED ACTIVITY IN STEADY-STATE OPERATION. Truffert, J.; Ollier, H. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)). 10 Jul 1974. 8p. (In English and French). (CONF-741017-27). Dep. NTIS (US Sales Only) $4.00.

From meeting on the American Nuclear Society; Washington, District of Columbia, USA (27 Oct 1974).

35170 (GEAP-13977) EVALUATION OF CAPSULE B9D LOW BURNUP FAILED LMFBR FUEL PERFORMANCE. Bohaboy, P. E.; Regimbal, J. J.; Craig, C. N.; Gilbert, R. S. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Nov 1974. Contract AT(04-3)-893. 96p. AT.

Two mixed-oxide fuel rods were purposely defected while operating at an average linear power of 15 kW/ft. The fuel rods were axially aligned and were essentially identical except for the defect location. The top fuel rod (B9D-1) contained a defect in the gas plenum; the bottom fuel rod (B9D-2) was defected at the axial midpoint of the 4.25 inch long fuel column. Irradiation in the defected condition continued to an average fuel burnup of 6600 MWd/Te. Samples of fission gases released by the failed rods were taken and analyzed at different time intervals during the test. Results of post-irradiation examination of the fuel, capsule hardware, and sodium coolant are presented. 21 references. (auth)

35171 (GEAP-14032-1) REFERENCE FUEL STUDIES FIRST QUARTERLY REPORT, AUGUST–OCTOBER 1974. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Nov 1974. Contract AT(04-3)-893. 5p. AT.

Three parts of Task 3 of Contract AT(04-3)-893 which have previously been reported separately will henceforth be reported together. These three parts are: a thermodynamic data program involving plutonia and urania at high temperatures; fuel rod engineering; and fuel rod test program. The three parts are closely interrelated and are in combination aimed at providing viable fuel rods for FTR, CRBRP, and commercial LMFBR's. All three parts are continuations of ongoing work which has been underway for several years. The previous quarterly progress report for the Thermodynamic Data Program is GEAP-12533, August 1974—the 28th in the series. Previous work on Fuel Rod Engineering and the Fuel Rod Test Program has been reported in GEAP-10028-51, August 1974—the 51st in the series. (auth)

35172 (HEDL-TME-74-4(Vol. 1)) HEDL QUARTERLY TECHNICAL REPORT, OCTOBER, NOVEMBER, DECEMBER 1974. Volume I. Applied Research and Materials Engineering. Evans, E. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jan 1975. Contract AT(45-1)-2170. 167p. AT.

The behavior of mixed oxide fuels heated rapidly to melting is analyzed. The compatibility of PuO_2–UO_2 fuel and stainless steel cladding is studied. The performance of niobium and titanium getter pellets for fuel pins is described. The development of control elements for the FFTF reactor is discussed. The tensile properties of Type 304 and Type 316 stainless steels are analyzed. The effects of radiation on the mechanical properties of Inconel 718, Inconel 600, and A-286 are presented. The corrosive effects of liquid sodium on Type 304 stainless steel are studied. Radionuclide transport in the FFTF core and primary sodium loop is analyzed. (DCC)

35173 (JAPFNR-179) EFFECTS OF BOWING DISTORTIONS ON HEAT TRANSFER IN A SEVEN-PIN BUNDLE. Haga, K.; Daigo, Y.; Ohtsubo, A.; Kikuchi, Y. (Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). Nov 1974. 11p. (CONF-741104-4; PNC-N-941-74-73). Dep. NTIS (U. S. Sales Only) $4.00.

From winter meeting of the American Society of Mechanical Engineers; New York, New York, USA (17 Nov 1974).

Work performed under United States–Japanese Fast Reactor Exchange Program.

The experimental results are presented of heat transfer in sodium flowing in an electrically heated seven-pin bundle where a pin was bowed to form a point contact. Each pin was 6.5 mm in diameter and had a 450 mm heated length. The bundle was tightly packed with 1.3 mm diameter spacer wires and placed in a hexagonal tube. The pitch-to-diameter ratio (P/D) was 1.22. The central pin was bowed symmetrically near the axial midplane to form a point contact with an outer normal pin. The measured temperature rise due to the point contact compared fairly well with the calculation by the PICO code. In addition, experiments were carried out with the normal pin bundle to establish a base case and to evaluate the effect of mixing due to spacer wires. When applying the experimental results to reactor conditions, the temperature rise due to a point contact is considered to be less than 30°K. (auth)

35174 (KFK-2106) DESIGN, IRRADIATION, AND POST IRRADIATION EXAMINATION OF THE UO_2/PuO_2: FUEL PIN IRRADIATION EXPERIMENTS OF THE BR2 CAPSULE GROUP MOL 8-B. Weimar, P.; Sebening, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Jan 1975. 116p. (In German). Dep. NTIS (U. S. Sales Only) $9.00.

For the Fast Breeder Project at Karlsruhe some irradiation experiments are conducted in the BR2 at Mol/Belgium. One series is the so-called Mol 8-experiments. The described experiment Mol 8-B is the pilot irradiation for the series Mol 8-C with continuous measurement of the fission gas pressure of the pin. The irradiation was performed in the so-called FAFNIR-NaK-capsule. The irradiation was performed in fuel-element positions of the BR2. The pin power was 354 and 387 W/cm respectively, the mean temperatures were 549 and 597°C respectively at the hot spot. The mean burnup was 89.5 and 74 MWd/Kg Me respectively. The irradiation time was 881 and 728 days. The pin Mol 8B-1 melted at two parts of the cladding, each some millimetre below the distance grid. The design, specification and fabrication as well as a detailed description of irradiation and post irradiation examination results are given. (auth)

35175 (MRR-136) ANALYTICAL ONE-DIMENSIONAL, ONE-CHANNEL MODEL FOR CALCULATING THE FREQUENCY RESPONSE AND STABILITY BEHAVIOUR OF SODIUM-COOLED REACTOR PLANT. Saedtler, E. (Technische Univ. Muenchen, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Mar 1974. 83p. (In German). INIS.

A model is presented which describes the frequency response and stability behavior of a sodium-cooled reactor plant with respect to any perturbations within the primary and secondary coolant systems. The theoretical work was based on a reactor plant concept incorporating a core, represented by a single coolant channel, a shell-and-tube type counterflow heat exchanger, and the appropriate coolant lines. In order to make the model applicable both to LMFBR type reactors (SNR-300, PHENIX, PFR) and to sodium cooled thermal reactors (KNK), two versions of coolant channels were included in the model. In the case of the fast fuel elements a simple coolant channel was assumed containing a number of cylindrical fuel rods. The lower and upper breeder region of the fuel elements can then be simulated by appropriate choice of the reactivity weighting function and the axial power distribution function. In the case of the KNK fuel element type the cylindrical fuel rods with the upward flowing liquid sodium are situated within the annular interspace of two hollow cylindrical solid (ZrH_x) moderator elements. (auth)

35176 (ORNL-TM-3624) LMFBR FUEL CYCLE STUDIES PROGRESS REPORT FOR OCTOBER 1971, NO. 32. (Oak Ridge National Lab., Tenn. (USA)). Dec 1971. Contract W-7405-eng-26. 76p. Dep. NTIS $7.00.

The development of methods for the reprocessing and fabrication of LMFBR fuels is reviewed. Development work is reported on problems of irradiated fuel transport to the processing facility, the dissolution of the fuel and the chemical recovery of the PuO_2-UO_2 values, the containment of volatile fission products, product purification, conversion of fuel processing plant product nitrate solutions to solids suitable for shipping, fuel fabrication of sol-gel materials, and fuel evaluation studies, both in-pile and out-of-pile. Pertinent experimental results are presented for the information of those immediately concerned with the field. Detailed description of experimental work and data are included in topical reports and in the Chemical Technology Division and Metals and Ceramics Division Annual Reports. (auth)

35177 (ORNL-TM-3724) LMFBR FUEL CYCLE STUDIES PROGRESS REPORT FOR JANUARY 1972, NO. 35. (Oak Ridge National Lab., Tenn. (USA)). Feb 1972. Contract W-7405-eng-26. 46p. Dep. NTIS $5.50.

The development of methods for the reprocessing and fabrication of LMFBR fuels is reviewed. Development work is reported on problems of irradiated fuel transport to the processing facility, the dissolution of the fuel and the chemical recovery of the PuO_2-UO_2 values, the containment of volatile fission products, product purification, conversion of fuel processing plant product nitrate solutions to solids suitable for shipping, fuel fabrication of sol-gel materials, and fuel evaluation studies, both in-pile and out-of-pile. Pertinent experimental results are presented for the information of those immediately concerned with the field. Detailed description of experimental work and data are included in topical reports and in the Chemical Technology Division and Metals and Ceramics Division Annual Reports. (auth)

35178 (WARD-CR-3045-7) CORE RESTRAINT DEVELOPMENT, PROGRESS REPORT FOR PERIOD ENDING NOVEMBER 30, 1974. Thompson, D. C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Feb 1975. Contract AT(11-1)-3045. 42p. AT.

The 121-assembly core restraint development tests were started during this reporting period. Phases I and II have been completed. Data are being analyzed and Phase I data have been issued to participants of the national program. The facility was characterized before testing was started. This characterization determines facility deflections under different loading conditions. This information reduces the error in recording peripheral jaw position. Storage racks have been installed in the assembly area. These racks will provide additional assembly space needed for the insertion and withdrawal fixture and additional assemblies. The new targets used in duct bow measurement have been procured and installed in the simulated assemblies. Full core Simulated Fuel Assemblies (SFA) are being designed and raw material procured. Changes in the CRBRP conceptual design terminated the work of the upper internals plug-in design concept. Design work and material procurement for these tests has been discontinued. An improved method for offsetting the above core load pad yoke of the alignment fixture has been developed and procured. This method will reduce setup time for alignment of SFA by 50 percent. The Instrumented Simulated Fuel Assemblies (ISFA) designed and fabricated by GE/BRO have been used in 120-assembly tests. Eight more instrumented assemblies are needed to continue testing at established schedules. Westinghouse has submitted a Development Activity Description (DAD) to RRD requesting the eight additional instrumented assemblies. The insertion/withdrawal system is being designed and procurement of raw material is in progress. (auth)

35179 EXPERIMENTAL STUDY OF SHIELDING CONCRETE TO BE USED FOR FAST BREEDER REACTOR. Uematsu, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)); Yamamura, T. Konkurito Janaru; 12: No. 6, 58-67(Jun 1974). (In Japanese).

In a fast breeder reactor of large type being developed in Japan, concrete is better used as shielding material than the graphite employed in an experimental reactor, because of structural and economical considerations. In this case, the concrete must also have good neutron shielding property as well as that for γ-ray and heat resistance. Experiments have been made on such concrete containing high water-content aggregate, serpentine in particular. (JA)

35180 ANALYSIS OF SODIUM VOID EFFECT. Nakagawa, M. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). pp 163-170 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese)

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

It is an important problem for safety to evaluate the reactivity resulting from sodium void effect in the nuclear design of fast neutron reactors. At the center of reactor core, the difference between measured values and calculated values can not be eliminated even by taking hetergeneous effect into consideration. This difference may be mostly caused by the uncertainty in scattering term. This uncertainty involves two phases, the one is the correctness of group cross sections and the other is due to analytical method. As to the nuclear data, by adjusting the cross section of heavy nuclides in JAERI Fast Set, the effect of the group cross sections was investigated. And the effective elastic scattering removal cross sections of light, medium and heavy nuclides were investigated. (JA)

35181 REACTOR CORE DESIGN AND REACTOR PHYSICS OF A LARGE-SCALE FAST BREEDER REACTOR. Nakagawa, H.; Inagaki, T. (Tokyo Electric Power Co. Inc. (Japan)); Shimizu, A.; Komatsu, I.; Yamashita, Y. pp 106-112 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese)

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

It is important to investigate whether mock-up experiment is necessary for the design of a large-scale fast breeder reactor. In large-scale fast breeder reactors, the variation of power distribution resulting both from the position of control rods and from the interference effect among control rods is very large. The interference effect on a control rod was evaluated by determining the worth of a control rod by two dimensional six group XY calculation. In order to investigate the variation of power distribution owing to the insertion of a control rod, the power distribution in initial and equilibrium core was evaluated by considering eight insertion patterns of control rods. As a result, the change rate of in-core maximum power density resulting from the insertion of a control rod exceeded 10%. (JA)

35182 FABRICATION TECHNIQUE OF JOYO FUEL. Matsumoto, K.; Ito, I.; Sasao, N.; Sakamoto, K. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works). Doryokuro Giho; 45-61(Mar 1974). (In Japanese).

86 fuel assemblies of JOYO's initial core are being fabricated and inspected at PNC's fuel fabrication factory. Technical aspects of fabrication and inspection are reported. The manufacture of PuO_2-UO_2 mixed oxide pellets is reviewed. Specifications, fabrication, and inspection are explained. Results of the statistical analysis on pellet diameter, density, and distortion are shown. The fabrication of fuel pins is reviewed. The process is explained with a flow sheet. The techniques for the welding of end plugs and the winding of spacer wire are discussed together with various results of measurements and statistical analysis. The methods and results of various strength tests performed on welded parts are also discussed. The fabrication of fuel assemblies is discussed with emphasis on welding technique. The techniques of fuel recovery and the disposal of waste liquid are discussed. The dry and wet recovery processes are explained with flow sheets and photographs of equipments. (JA)

35183 FISSION RATIO IN BLANKET REGION OF FAST REACTOR SYSTEM. Mizoo, N.; Hirota, J. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). pp 140-149 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese)

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

The ratio of calculated value and measured value of fission rate distribution in fast reactor system becomes smaller with increasing distance from the center of reactor core, and reaches minimum at the outer edge of blanket region. In the VI-1 core system, a partial mock-up core system of the prototype fast reactor "Monju," the distribution of nuclear fission rate of ^{238}U was measured by foil activation method and was compared with that with micro fission chamber. The data on foils showed large errors, but the streaming effect at a hole generates larger error than that. In the V core system, mock-up of the experimental fast reactor "Joyo," it can be considered that there is little streaming effect regarding U-235 micro fission chamber, but the streaming effect contributes about 30% to the result of U-238 micro fission chamber. The effect of coaxial signal cables can be considered to be negligible in reactor core, but in the blanket region, several percent higher value was measured. As a result, it must be taken into consideration that the streaming effect of

U-238 micro fission chamber in a testing hole is from 30 to 40%, and the effect of coaxial cables on U-235 micro fission chamber is several percents in blanket region. (JA)

35184 EXPERIMENT AND ANALYSIS OF SODIUM VOID EFFECT IN FCA I-1 ASSEMBLY. Shirakata, K.; Kurol, H.; Hirota, J. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment); Mita, T.; Goto, Y. pp 156-162 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese).

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

VI-1 assembly is a physical mock-up of the prototype fast neutron reactor "Monju." The correlation between the experimental values and calculated values of sodium void effect was investigated in this VI-1 assembly. The analysis of the sodium void effect was performed as follows. First, by using JAERI-Fast 70 group cross section set, calculation of one dimensional P1 criticality was performed by P1 FRAU, calculation of one dimensional perturbation by P1 PERT and calculation of two dimensional diffusion by CITATION. Secondly, in two dimensional calculation, calculation of R-Z perturbation and direct calculation were performed by 26 group contracted effective cross sections. Results are presented. (JA)

Research, Test, and Experimental Reactors

Refer also to abstracts 33252, 33716, 34006, 35133, and 35174.

35185 (AECL-4760) HYDROGEN DISTRIBUTION IN A ZIRCONIUM SHEATH WITH A GAS PLENUM. Sawatzky, A. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Jan 1975. 55p. Dep. NTIS (US Sales Only) $5.75. AECL $1.50.

Some experimental fuel elements in WR-1, an organic-cooled nuclear reactor, consisted of uranium carbide (UC) pellets inserted into tubular zirconium sheaths with gas plenums about 1 cm long at the upper ends. After 200 days operation, several sheaths defected over the plenum. Metallographic examination showed heavy hydriding in this region whereas the sheath over the fuel adjacent to the plenum was relatively unhydrided. The sheath temperature over the fuel was about 150°C hotter than over the plenum so that thermo-transport caused hydrogen to diffuse from the hotter to the colder region. A model based on this assumption predicted that a 5 to 12 cm length of sheathing next to the plenum/fuel interface would be free of hydride at the operating temperature; the hydrogen picked up from the coolant over this region diffusing to the plenum. A mathematical expression was derived which enables the sheath temperature and the hydriding rate to be calculated if the length of the hydrided region and the hydrogen distribution over it are known. Results obtained were in excellent agreement with those using other methods. The regular WR-1 fuel, uranium dioxide (UO_2), which has zirconium wires spot-welded to the sheathing to serve as hydrogen sinks, has not experienced the same degree of hydriding over the plenum. The mathematical analysis was extended to this case and showed how the hydrogen distribution in the sheath over both fuel and plenum was determined by the size of the wire wrap. (auth)

35186 (AECL-4763) WR-1 REACTOR: A GENERAL DESCRIPTION. Turner, D. G. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Nov 1974. 118p. Dep. NTIS (US Sales Only) $9.00. AECL $2.50.

Whiteshell Reactor No. 1 (WR-1) is an organic cooled, heavy water moderated, vertical pressure tube reactor with a nominal thermal output of 60 MW. WR-1 is used primarily as an irradiation facility for testing nuclear reactor materials, components, experimental fuels and coolants. Tests may be carried out both in normal reactor fuel sites, and in experimental loops having their own independent cooling systems. Specimens may also be irradiated using a pneumatic carrier system which occupies one reactor site. This general description includes illustrations and basic data of the reactor structure, the cooling, protective and auxiliary systems, fuel and experimental facilities. A summary of reactor data is also included. (auth)

35187 (ANL-8146) INITIAL IN-SERVICE INSPECTION OF DUPLEX TUBES IN EBR-II EVAPORATOR EV-702. Reimann, K. J.; Sather, A. (Argonne National Lab., Ill. (USA)). Feb 1975. Contract W-31-109-eng-38. 14p. AT.

An initial in-service inspection of evaporator tubes from the inside (water side) was conducted to establish the feasibility of using ultrasonic shear waves as a nondestructive technique. A special transducer manipulator was designed so that the same transducer could be used to generate shear waves for defect detection and longitudinal waves for wall-thickness measurements. The experimental test arrangement was used to examine 19 tubes in evaporator EV-702 to a depth of ~14 ft. In five of the inspected tubes, ultrasonic reflections from outside-surface abnormalities were obtained. The results, with regard to the position of these abnormalities, were reproducible; however, the amplitude variation during repeated tests exhibited a wider spread. Wall-thickness measurements were performed after the collimator was attached to the transducer. No wall thinning could be detected with visual observations of time-delay variations. Borescope examination of the evaporator tubes did not reveal any pitting or other surface phenomena. (auth)

35188 (FZK-343) NERVA IRRADIATION PROGRAM. Mapping of the Radiation Field Within the In-Pile Tube of the Aerospace Systems Test Reactor. Lewis, J. H.; Bullock, R. E.; Kunselman, J. S. (General Dynamics/Fort Worth, Tex. (USA)). 15 Nov 1967. 117p. Dep. NTIS $9.00.

The core of the 10-MW Aerospace Systems Test Reactor has been modified to provide an in-core irradiation facility. This facility consists of a tube with an inside diameter of 3.75 in. This in-pile tube occupies a former fuel-element position near the center of the core and extends completely through the core. It is plugged at one end and extends through the forward pressure plate of the reactor. The tube is completely sealed so as to provide a dry irradiation volume in the high-flux region within the reactor core. To provide data on the radiation field within the in-pile tube for use in planning radiation-effects experiments, an extensive mapping of the neutron and gamma-ray fields has been conducted. The primary effort was the axial mapping of the heating rate by means of a pedestal-type aluminum calorimeter. Additional data on the gamma field were obtained by means of a 4-cc ion chamber and gamma dosimeters (cobalt glass and thermoluminescent). Neutron fluxes were measured with foils of various types. (auth)

35189 (GSF-P-64) ANNUAL REPORT 1973. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Physikalisch-Technische Abt.). Mar 1974. 145p. (In German). INIS.

Activities of the Physical/Technical Department of the GSF are described for the year 1973. The main fields of activity are the operation of the FRN reactor, neutron and gamma flux measurements, operation of three particle accelerators, studies of radiation effects in solid state matter, and data processing problems. (GE)

35190 (HEDL-TME-74-4(Vol.2)) HEDL QUARTERLY TECHNICAL REPORT, OCTOBER-DECEMBER 1974. Volume 2. Fuels and Component Fabrication. Evans, E. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Feb 1975. Contract AT(45-1)-2170. 63p. AT.

Information is presented concerning the development and performance testing of FFTF reactor core components, radiation exposure levels from the fabrication of PuO_2-UO_2, and the development of fabrication and testing equipment for FFTF reactor core components. (DCC)

35191 (NP-20338) SCOTTISH UNIVERSITIES RESEARCH AND REACTOR CENTRE. (Scottish Research Reactor Centre, East Kilbride (UK)). 11 Jan 1975. 15p. Dep. NTIS (US Sales Only) $4.00.

The location and layout of the centre are described, and its facilities and programmes are summarized under the following headings: the reactor; reactor experimental facilities; experimental work using the reactor; cobalt-60 irradiation rig; computer; nuclear medicine studies; isotope geology unit; radiocarbon laboratory. (UK)

35192 (ORNL-TM-4879) HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT: OCTOBER, NOVEMBER, AND DECEMBER OF 1974. McCord, R. V.; Corbett, B. L. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 22p. Dep. NTIS $4.25.

Reactor operation was routine this quarter with an on-stream time of 93.5% which brought the on-stream time for the year up to 88.1%. A scheduled re-examination of the cracked beryllium showed that a circumferential crack on the inside surface has propagated, probably completely around the assembly. Premature failure of another control plate bearing was experienced. (auth)

35193 (WANL-TME-690) DESIGN MANUAL AND HAZARDS ANALYSIS FOR EXPERIMENT RE-1 DOSIMETRY TEST AT PLUM BROOK REACTOR FACILITY (RFI, 63-05). Schlueter,

J. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Feb 1964. 11p. Dep. NTIS $4.00.

Experiment No. RE-1 is an irradiation test to provide dosimetry data for HT-1 of the Plum Brook Reactor. It will be conducted in the W-2 water loop of the Plum Brook Reactor Facility (RFI, 63-05). The purpose of the test is to determine the spatial variation of neutron flux in the W-2 capsule which is utilized in the testing of NERVA components in the HT-1. The neutron flux energy spectrum will be defined in three levels: sub-cadmium (<.48 eV), epi-cadmium (>.48 eV) and epi-sulfur (n,p) (>2.9 MeV). (auth)

35194 (WANL-TME-690(Rev.1)) DESIGN MANUAL AND HAZARDS ANALYSIS FOR EXPERIMENT RE-1 DOSIMETRY TEST AT PLUM BROOK REACTOR FACILITY (RFI, 63-05). Schlueter, J. H.; Llewellyn, E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 4 Mar 1964. 14p. Dep. NTIS $4.00.

Experiment No. RE-1 is an irradiation test to provide dosimetry data for HT-1 of the Plum Brook Reactor. It will be conducted in the W-2 water loop of the Plum Brook Reactor Facility (RFI, 63-05). The purpose of the test is to determine the spatial variation of neutron flux in the W-2 capsule which is utilized in the testing of NERVA components in the HT-1. The neutron flux energy spectrum will be defined in three levels: sub-cadmium (<.48 eV), epi-cadmium (>.48 eV) and epi-sulfur (n,p) (>2.9 MeV). (auth)

35195 (WANL-TME-954) PIPING SPECIFICATION FOR NASA LEWIS RESEARCH CENTER, PLUM BROOK STATION, SANDUSKY, OHIO. Johnson, F. T. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1964. 27p. Dep. NTIS $4.50.

The specification established the requirements for the piping system for use with the W2-3 water-cooled inpile capsule to be located at NASA-Lewis Research Center, Plum Brook Station, Sandusky, Ohio. The specification covers the contractor's responsibility for furnishing all materials, except as noted, tools, construction equipment, facilities, scaffolding, etc., and performing all labor and services of every description as may be necessary for and reasonably incidental to the proper installation, testing and completion of all the piping systems, whether specifically mentioned on the drawings, or as specified herein and/or reasonably implied thereby, to carry out the apparent intent of the work. (auth)

35196 (WANL-TME-1046) DOSIMETRY TEST EXPERIMENT RE-2 IRRADIATED AT PLUM BROOK REACTOR FACILITY, PBRF CYCLE 28P (PB NO. 9W). Preliminary Data Report. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Dec 1964. 13p. Dep. NTIS $4.00.

Dosimeters were irradiated to determine the spatial and energy distribution of the neutron flux in the W-2 capsule, located in HT-1 of the Plum Brook Reactor. The test, designated as Experiment RE-2, was conducted on November 22 to November 23, 1964. (auth)

35197 (WANL-TMI-1866) "RABBIT" SPECIMEN TRANSFER SYSTEM, CONCEPT REPORT. Brown, R. K.; Hanks, J. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1968. 28p. Dep. NTIS $4.50.

The cryogenic transfer of irradiated material test specimens from the tip of the W-1 capsule to the jaws of a testing machine is a very formidable and intriguing problem. The "rabbit" concept of specimen transfer provides a unique and satisfactory method for overcoming the environmental barrier between the interiors of the W-1 capsule and the transfer vessel. The "rabbit" concept is completely feasible from a design, fabrication, and operations standpoint. The system can be designed and built in a reasonable length of time utilizing existing technology and capabilities of the Astronuclear Laboratory. The design, fabrication, and installation cost of the "rabbit" system would be no higher than any other transfer concept and is considerably less than some. (auth)

35198 THE PRELIMINARY DESIGN OF THE EXPERIMENTAL MULTIPURPOSE HIGH TEMPERATURE GAS COOLED REACTOR. Tsunoda, R. (Fuji Electric Co. Ltd., Tokyo (Japan)). 19: No. 2, 73-82(1973).

An outline of the results of the secondary preliminary design performed in 1971 of the experimental multipurpose high temperature gas cooled reactor is given. Improvements, detailed design, and additional studies based on the preliminary design conducted in 1970 were performed in this research and development, which completed the preliminary design stage. This experimental reactor has a thermal output of 50 MW and a remarkable reactor outlet coolant gas temperature of 1000°C. Changes may be made in the final design in the future, but the problem points and their counter measures are now known. (auth)

35199 NEUTRON RADIOGRAPHY EXPERIMENTS AT JRR-4. I. Tomii, K. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment); Matsumoto, G.; Sato, O.; Takagi, K.; Hattori, I. J. Nucl. Sci. Technol. (Tokyo); 11: No. 4, 153-157(Apr 1974).

JRR-4, which is a swimming pool type reactor (2.5 MWt), is particularly suitable as a source for neutron radiography. The first phases of neutron radiography experiments at JRR-4 are reported. A simple Al tube (I. D. = 60 mm) with a graphite block (100 × 100 × 700 mm) attached at the end was inserted in the pool (10 m deep) and the graphite block was positioned close to the reactor core. The upper part of the tube was curved to avoid direct radiation streaming from the core. Using both the direct exposure method (DEM) and the transfer (indirect) exposure method (TEM), the device thus arranged was tested to determine its performance in terms of sensitivity, resolution, and contrast. Two examples of application are described, namely, determination of the enrichment of UO_2 pellets, and detection of small quantities of hydrogenous material. (auth)

35200 PLAN OF PULSED NEUTRON REACTOR "YAYOI." An, S.; Tamura, T.; Furuhashi, A.; Wakabayashi, H. (Tokyo Univ. (Japan). Nuclear Engineering Research Lab.). pp 41-50 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese)

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

The fast neutron source reactor "YAYOI" has been developed along the original plan that "YAYOI" should be a pulsed neutron reactor in connection with a linear accelerator. The unsteady operation with pile oscillators POS 1 ~ 4 was experienced for the first time in the world. The fields which are scheduled to be researched with a pulsed neutron reactor "YAYOI" cover (1) the dynamic characteristics of fast neutron reactor system, (2) neutron spectrometry, (3) development of instrumentation, (4) development of fast repetition type pulsed reactor, and (5) pulse radiolysis of fission neutrons. The characteristics of core structure of "YAYOI" are based on those of HARMONIE. (JA)

35201 IC LOGIC REACTOR PROTECTION SYSTEM. Horiguchi, N.; Sato, M. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)); Hayashi, S. Toshiba Rebyu; 29: No. 9, 807-810(Sep 1974). (In Japanese).

Protection systems for nuclear reactors are required to have high functional performance and high reliability of operating reactors with safety. This IC logic protection system, intended for protection of "JOYO" (Japan experimental fast reactor), has been designed by the use of IC modules so that it may have high reliability and may be tested while the plant is in operation. (auth)

35202 PRESENT STATUS OF THE FAST CRITICAL EXPERIMENT AND ANALYSIS. Hirota, J. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). pp 113-119 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese)

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

From February 1969 to May 1972, the mock-up test of the experimental fast reactor "JOYO" was performed by using the Vth core system of a fast critical assembly (FCA). This Vth core system is composed of physical parts, full mock-up and technological mock-up. Main purposes of this mock-up test of "JOYO" were the decision of plutonium enrichment and specification of B_4C control rods of "JOYO" and the acquisition of necessary data to calculate power distribution. These integral data were fed to the design of "JOYO." After the mock-up test of "JOYO," the FCA started the mock-up test of the prototype fast neutron reactor "MONJU." The physical mock-up test on the enrichment of plutonium and on the reactivity coefficient was performed in Vth core system. After this, the technological mock-up test is scheduled to be performed in VIIth core system. The VI-1 assembly is a zone type assembly composed of a test zone simulating the outer core of "MONJU" and a driver zone of U-235. This assembly reached criticality in August 1972. In this assembly, the decision of heterogeneous critical mass, the measurement of density coefficient, sodium void experiment, Doppler experiment and the measurement of neutron spectrum by using He-3 proportional counters were performed so far. (JA)

35203 REACTIVITY MEASUREMENT OF VTH-REACTOR CORE SYSTEM OF FAST CRITICAL ASSEMBLY (FCA) BY PULSED NEUTRON METHOD. Nakamura, T.; Hiraoka, T.

(Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). pp 130-139 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese)

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

The reactivity worth of ^{10}B control rod in the technological mock-up of "JOYO" was measured by pulsed neutron method, and was compared with the results of other methods. The systematics between a decay constant α and reactivity ρ was investigated in detail. In the past, the relation between α and ρ has been investigated in the FCA by pulsed neutron method. In V-3 system, experiment showed the non-proportional relation between α and ρ, perhaps because the value l_p was changed by the insertion of a 10_B control rod. The value $\alpha/(1+\rho)$, corresponding to β_{eff}/Λ_p in one point kinetics, increased with 10_B insertion and decreased with the removal of fuel. (JA)

35204 PROBLEMS ON THE ANALYSIS OF REACTOR CORE WITH METAL REFLECTOR. Yoshida, T.; Iijima, S. (Nippon Atomic Industry Group Co. Ltd., Tokyo). pp 150-155 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese)

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

As one of the development programs of experimental fast reactor "Joyo," the construction of Mark II reactor core with stainless steel reflector is planned. Therefore, with FCA-V-2-R, a mock-up of the Mark II reactor core, and ZPR-III-54, a soft spectrum reactor core with iron reflector, several analyses were performed on nuclear characteristics. It was found that eigenvalue of criticality in each reactor system was able to be estimated correctly when only the effect of outer materials could be understood well. It was found that the rate of central reactivity was little affected by replacing blanket with reflector. The calculated distribution of fission reactivity was much lower than measured in the outer region from core circumference in the reactor system with iron reflector. (JA)

35205 HETEROGENEOUS EFFECT IN ZPPR-2 ASSEMBLY. Kamei, T.; Yamamoto, M. (Nippon Atomic Industry Group Co. Ltd., Tokyo). pp 171-179 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Socitey of Japan (1973). (In Japanese)

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

Effective multiplication factor, reactivity worth of major materials, central reactivity ratio and Doppler reactivity in ZPPR-2 were analysed by taking heterogeneous effect into consideration, and they were compared with the results of homogeneous calculation. As a cross section set, 25 group cross sections of NNS-5 set (ABBN type) were utilised. In homogeneous model, usual two-dimensional RZ calculation and perturbation calculation were performed. In heterogeneous model, effective cross sections were calculated by one-dimensional integral transfer code, and two-dimensional RZ diffusion calculation and perturbation calculation were carried out. (JA)

35206 ANALYSIS OF EXPERIMENT ON FCA-V CORE SYSTEM BY AGLI LIBRARY. Tone, T.; Kuroi, H.; Koyama, K.; Hirota, J. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). pp 180-189 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese)

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

The analytical results of experiments in the V-1 and V-2 core systems of FCA (Fast Critical Assembly) by using AGLI library and analytical code DOYC are presented. The AGLI library is a fine group cross section library with 1950 energy groups. It can smoothly reproduce the cross sections of light, medium and heavy nuclides and can precisely indicate the resonance cross sections of heavy nuclides. The analytical system DOYC can produce coarse group cross sections corresponding to any region by using the neutron spectrum calculated by the AGLI library. As to the estimation of effective multiplication factor, AGLI/1 is improved remarkably as compared with AGLI/0, particularly in a large core system. The analytical values and measured values of fission ratio in the central core regions of FCA V-1 and V-2 were compared with each other. The fission ratio of $^{239}Pu/^{235}U$ is greatly improved by AGLI/1, but $^{238}U/^{235}U$ is not improved. This is because the inelastic cross section of ^{238}U is not correctly evaluated as well as the fission cross section. (JA)

35207 NEUTRON SPECTROSCOPY OF FAST NEUTRON REACTOR "YAYOI." Akiyama, M. (Tokyo Univ. (Japan)). pp 255-264 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese)

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

The measurement of neutron spectra in the fast neutron source reactor "YAYOI" was performed around the core region. The measured values with various detectors were compared with each other. The employed neutron detectors and methods were a ^6Li sandwich counter, an organic scintillator (NE-213 and stilbene), a ^3He counter, emulsion and fission track method and foil activation method. The completely close adherence type ^6Li sandwich counter was developed aiming at high detection efficiency because the neutron spectrum of "YAYOI" is very hard. The measured data with this counter show higher S/N ratio than that when being measured in usual nuclear fission spectra. The measurement with the organic scintillator was performed by three groups independently. The foil activation method employed threshold type reaction. The radiation of activated foils was measured by 3'' $\phi \times 3''$ h NaI ·Tl' scintillator and 2 c.c. Ge (Li) detector. The results are summarized. (JA)

35208 EQUIPMENT FOR MEASURING THE THERMAL CONDUCTIVITY AND ELECTRICAL CONDUCTIVITY OF METALS IN THE RADIATION FIELD OF THE ACTIVE ZONE OF A NUCLEAR REACTOR. Starodubtsev, S. V.; Makhkamov, Sh. A.; Gurvich, L. G.; Ivanov, L. A.; Lazutkin, N. T.; Polyak, Yu. V. pp 364-367 of Fizicheskaya Elektronika, Materialy Elektronnoi Tekhniki i Prikladnaya Fizika. Arifov, U. A. (ed.). Tashkent; Izdatel'stvo Fan Uzbekskoi SSR (1974). (In Russian).

A unit is described in which the sample is clamped between two electrodes and placed in an evacuated channel within a reactor. The temperature is measured with thermocouples. Edge heaters are used to balance temperature losses. Temperature differences between the center and edges of the sample are measured at two different reactor power levels. From the readings of the thermocouples, the voltage drop on the sample, the current strength and the reactor power it is possible to calculate the electrical resistance and thermal conductivity of the sample. (SJR)

35209 STEAM GENERATOR FAILURE AT THE KNK-REACTOR PLANT. Lorenz, H.; Herberg, G. pp 299-303 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

During the operation of the KNK (compact sodium cooled reactor\) the reactor was manually scrammed because of overpressure in a part of the secondary Na loop. The construction of the steam generator heated by the secondary Na loop is described, and it was concluded that the over-pressure was caused by a leak in this circuit. The techniques used for locating the site of the leak and for determining its cause are described. The methods used in the construction of the steam generator and recommendations for altering the construction techniques in order to avoid a repetition of the failure are discussed. (JSR)

35210 THERMIONIC ENERGY CONVERSION. Takahashi, S.; Amano, F. (Electrotechnical Lab., Tanashi, Tokyo (Japan). Tanashi Branch). Oyo Butsuri; 43: No. 7, 656-669(Jul 1974). (In Japanese).

The present status of research and development on thermionic converters and thermionic reactors is described. The future trends of converter technology and possible applications for utilization of thermionic reactors are also discussed. A thermionic converter consists of two refractory metal electrodes facing each other, closely and it is such a device that converts heat energy into electrical energy directly by utilizing the thermionic emission of electrons. The electrical output characteristic of a cesium vapor converter shows two modes of operation, ignited mode and unignited mode, but a practical operation mode is analyzed as compared with the idealized mode. The theoretical analysis in the USSR of internal phenomena between the electrodes is briefly reviewed. Various methods for improving the converter performance are proposed by utilization of a new generation of electrode materials and structures. The energetic research and development work on the thermionic reactor—a reactor with a number of power-producing thermionic converters in the core—is being carried out in many advanced countries. The USSR provided the most significant demonstrations of thermionic thermal reactor technology (TOPAZ I and II) in 1971. The USSR is being concentrated on power sources for telecommunication satellites and terrestrial applications. The US is carrying out the research and development work on the

thermionic fast reactor as a power source for electric propulsion of spacecrafts. (auth)

35211 TEST STUDY OF OGL-1 SAFETY. Thermal Shock Test of In-Pile Loop. Izaki, T.; Fukuhara, M. (Kawasaki Heavy Industries Ltd., Kobe (Japan)). FAPIG (Tokyo); No. 71, 156-166(Nov 1973). (In Japanese).

An in-pile test loop is going to be installed in JMTR to study HTGR fuels and materials. High temperature and high pressure helium gas flows inside quadruple concentric tubes, and the outside of the outermost tube is cooled by cooling water. If the outermost tube is broken, the inner tube is subjected to thermal shock. Studies of the effects of the thermal shock are described. Heat transfer rate at the time of cooling by jet flow was determined. The heat transfer coefficient α was in the range between 10,000 ~40,000 k cal/m^2.h.°C. The effects on electron beam-welded seam at the time of thermal shock were studied. Distortion, hardness, strength, and structure were measured. Failures were not observed. Slight increase in the hardness of material was measured. Microscopic photographs showed that the structure of material did not change appreciably. Hydrostatic pressure testing to failure was performed. Failure did not occur at the welded joint. Values of circumferential stress at break down were normal. It was concluded that no serious effect will be seen in the OGL-1 under the considered thermal shock condition. (JA)

Production and Materials Testing and Processing Reactors

Refer also to abstracts 33810, 35133, and 35561.

35212 (CEA-CONF-2815) HEAT-PRODUCING SWIMMING POOL REACTOR AND ITS USE FOR URBAN HEATING, DESALINATION OF WATER, AND OTHER INDUSTRIAL APPLICATIONS. Lerouge, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Div. d'Etude et de Developpement des Reacteurs). 3 Sep 1974. 30p. (In French). (CONF-740983-1). Dep. NTIS (U. S. Sales Only) $4.50.

From study group of the use of the heat of reactor by industry and for urban heating; Vienna, Austria (2 Sep 1974).

The advantages of a purely heat-producing reactor, operating at very low temperature in order to provide specific heat needs are discussed. The heating needs considered are urban heating, desalination of water, and other industrial applications. The concept of a swimming-pool type reactor furnishing hot water at 110°C is presented and the possibilities of putting such a reactor into operation and inserting it into an industrial complex are analyzed. The problem of the economic optimization of a mixed fissile-fossil installation for urban heating is considered and analyzed in detail. (tr-auth)

35213 (HW-66717) SIMULATED NPR RUPTURES OF IRRADIATED FUELS IN AN OUT-OF-REACTOR LOOP. Hayden, K. D.; Neibaur, G. E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Mar 1961. Contract AT(45-1)-1350. 38p. Dep. NTIS $5.00.

Declassified 27 Mar 1975.

Rupture studies were made in an out-of-reactor loop with previously irradiated coextruded uranium-Zircaloy-2 rods. At 300°C, the rupture rate was increased threefold from 0-MWD/T exposure to 2250-MWD/T exposure. The New Production Reactor scram and normal water cool-down rates were used with rods which had been irradiated in either a KER loop at 250°C for 2250 MWD/T or in a KW test hole at 35°C for 2400 MWD/T. The scram cool-down resulted in rupture reductions by factors of 11 and 37, respectively, over the normal cooldown. In all cases, the rupturing essentially had stopped when the water temperature was below 200°C. (9 references) (auth)

35214 GASIFICATION OF COAL WITH HEAT FROM A NUCLEAR REACTOR. Juentgen, H.; van Heek, K. H.; Klein, J. (Bergbau-Forschung G.m.b.H., Essen (F. R. Germany)). Chem.-Ing.-Tech.; 46: No. 22, 937-943(Nov 1974). (In German).

5 figs.; 4 tabs.; 18 refs. Also issued as AED-Conf-74-490-001.

Studies on gasification kinetics and heat transfer led to the conception of an allothermic gas generator in which helium-heat is transferred via an intermediate cycle from the reactor to a coal/steam fluid bed by means of a heat exchanger projecting into the fluid bed. About 50 t/h of coal can be gasified given a helium temperature of 950°C, a fluid bed volume of 318 m^3, and a heat transfer area of 4,000 m^2. The purpose of the current research and development program is to enable a demonstration plant to be run by 1983/84. (auth)

35215 TECHNICAL AND ECONOMIC ASPECTS OF THE UTILIZATION OF HEAT FROM NUCLEAR POWER PLANTS FOR HEATING PURPOSES. Muehlhaeuser, H. (Brown, Boveri and Co. Ltd., Baden (Switzerland)); Helbling, W. (Sulzer Bros. Ltd., Winterthur (Switzerland)). VGB Kraftwerkstechnik; 54: No. 12, 775-782(Dec 1974). (In German).

Nuclear energy could be an ideal replacement for the proportion of energy required for district and domestic water heating, which is provided by oil and which represents about a third of total energy. Various possibilities of using nuclear energy for district heating are outlined. In this way a considerable proportion of fuel oil consumption for district heating could be replaced in the long term by nuclear fuel. (auth)

Propulsion and Package Reactors

Refer also to abstracts 32619, 32809, 32810, 32815–32817, 32820–32822, 32824, 32825, 32958, 32961, 32972, 32973, 32976, 32977, 32996, 32999, 33290, 33291, 33704, 33724–33728, 33779–33781, 33802, 33805, 33807, 33862, 33863, 33870, 33871, 33887–33889, 33893–33902, 33994–33997, 34002–34004, 34006, 34032, 34033, 34039–34041, 34043–34048, 34101, 34102, 34105, 35532–35534, 35537, 35538, 35540–35544, 35612, and 35614–35619.

35216 (ACF-411-270) NRX-A4/EST PRIVY ROOF MOUNTED SHIELD AND SUPPORT TEST REPORT. Arnold, C. E. (ACF Industries, Inc., Albuquerque, N. Mex. (USA)). 29 Nov 1965. 37p. Dep. NTIS $5.00.

The results of testing the NRX-A4/EST Privy Roof Mounted Shield and Support, in accordance with Procedure ACF-411-261, are presented. All components successfully met or exceeded the design requirements for structural integrity. Pressure drops between the Simulated Reactor Support Test Stand and the Support exceeded design requirements but were acceptable within over-all system requirements. Other flow parameters were within design requirements. (auth)

35217 (ACF-431-135(Rev. 1)) SCOPE OF WORK FOR NERVA-NRX-A REACTORS, AEC FY 66. Stuever, J. H. (ACF Industries, Inc., Albuquerque, N. Mex. (USA)). 10 Sep 1965. 68p. Dep. NTIS $6.50.

35218 (ACF-SA-727) PRIVY ROOF MOUNTED SHIELD AND SHIELD SUPPORT. Design Progress Report. Martin, L. P. (ed.). (ACF Industries, Inc., Albuquerque, N. Mex. (USA)). 15 Jun 1965. 368p. Dep. NTIS $21.50.

Initial designs, analyses, material investigations and testing efforts for the NRX Privy Roof Mounted Shield and Support are reported. The guiding philosophy followed in planning specific activities was to give the greatest priority to those analyses concerned with the primary loads on the shield, i.e., the temperature distributions due to the internal heat generation within the shield structure and the stresses due to internal coolant water pressure and thermal effects. Alternative design concepts were considered but rejected. The present design is similar to the NRX-A3 shield, but with substantial and important design differences. (auth)

35219 (AGC-746-15) FUNDAMENTAL FREQUENCIES OF THE NERVA EXHAUST DUCT STRUCTURE. Soo, P. P. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1964. 36p. Dep. NTIS $5.00.

A method for the determination of free flexural vibration characteristics of the NERVA Exhaust System (NES) duct is summarized. The NES duct was treated as a non-uniform, continuous L-bent structure, and the determination of the fundamental frequencies involves the solution of a fourth order partial differential equation with variable coefficients. As in a closed form solution, this higher order equation was reduced into two second order equations of the Bessel type. The NES duct was broken into five segments and the frequency equation, in terms of the known parameters of each segment, was reduced from a set of twenty characteristic equations. Solution of this frequency equation will yield the desired natural frequencies of the NES duct. (auth)

35220 (AGC-1772) DESIGN STUDY OF ENGINE CONTROLS AND REACTOR INSTRUMENTATION FOR A NUCLEAR FLIGHT TEST ENGINE. Final Report. (The Bendix Corporation, Research Laboratories Division, Southfield (Detroit), MI (USA)) 3 Apr 1961. 302p. Dep. NTIS $18.25.

The objectives of this program are to analyze and prepare preliminary designs of all engine control system components, nuclear instrumentation components, and auxiliary power supply equipment. In addition, guidance and telemetry studies will be made on the basis of assumed missions to insure that the interactions between the engine system and telemetry and guidance are properly treated. Special problems affecting guidance and telemetry, arising from nuclear engine performance requirements and environment, will be defined. (auth)

35221 (AGC-2014(Vol.5)) BENDIX NERVA PROGRAM. Final Report, Phase I. Volume V. Technical Assistance to Aerojet-General Corporation. (Bendix Corp., Southfield, Mich. (USA). Research Labs. Div.). 10 Jan 1962. 37p. Dep. NTIS $5.00.

A survey of state-of-the-art designs of radiation-tolerant pressure transducers and a few other instruments was made and a list of specifications for such transducers in NERVA applications was drawn up. Radiation heating and radiation damage effects were calculated. A list of instrument manufacturers was provided. Instrumentation and supporting test circuitry was listed for defining actuator subsystem performance. Hard lines were considered more suitable than telemetry for recording instrument values up to 1500 ft distant, using shielded cable for all low-level and other critical signals. Engineering support was provided on control drum actuator tests and other reactor experiments. (LTN)

35222 (AGC-2220A) DUCT-FLOW VISUALIZATION STUDIES SCALE-MODEL PROGRAM FOR TEST CELL "D" EXHAUST SYSTEM. (Aerojet-General Corp., Sacramento, Calif. (USA)). Aug 1962. 61p. Dep. NTIS $6.25.

A flow visualization study was made, using a two-dimensional scale model of an ejector duct (which was under consideration for use in Test Cell "D" when testing the NERVA engine) to determine qualitatively phenomena of shock-wave and flow separation. The experimental program consisted of operating the ejector at different chamber pressures, while spark and motion-picture shadowgraphs were being made of the flow. Static pressures along the ejector walls were measured for correlation with the three-dimensional model tests as reported in Aerojet Report 2309. Conclusions are drawn and recommendations are made as a result of the experimental data. (auth)

35223 (AGC-2414(Vol.1)) SECONDARY GAS GENERATOR SYSTEM PRELIMINARY DESIGN. Volume I. Final Report. Haygood, J. M. (Aerojet-General Corp., Azusa, Calif. (USA)). Nov 1962. 115p. Dep. NTIS $8.75.

The objective of this study program was to procure a preliminary design of a gas generator system utilizing LO_2/LH_2 in accordance with agreed-upon ground rules. This gas generator system is to be used to provide the ejector-nozzle working fluid for the REON eductor tube which will maintain a vacuum during altitude simulation testing of the NERVA engine. A preliminary design was made to demonstrate the feasibility of such a system and to approximate the costs. This system will use a feed mixture ratio of 1.14 and provide a full flow output of 210 lb/sec of combustion gas at a temperature of 1560°F, a pressure of 320 psia, and T/M value of 468°R lb-mol/lb. A duration of 1 hour per start at a specified duty cycle and a minimum of 200 starts were required. The system chosen was for one generator, about 19-in. ID and 5-ft long, to provide the full gas production requirement while two identical redundant units operate on pilot flame standby. Each gas generator will be mounted on a separate skid with its associated valves, pipes, etc. Each generator is controlled by a separate control system rack mounted in a protected building. An executive switching function is used to change the units in case of a malfunction. Three cost estimate alternates are presented. The ROM cost estimate to deliver two gas generator systems (six generators) to the Nevada Test Site is $4,372,886. To deliver one gas generator system, the ROM cost estimate is $4,017,256; to deliver one additional gas generator system, ordered after the completion of either of these development programs, the ROM cost estimate is $689,736. All of the above costs are based on government-furnished propellants and include general and administrative overhead. (auth)

35224 (AI-AEC-12998) SNAP REACTOR PROGRAMS PROGRESS REPORT, FEBRUARY-APRIL 1971. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Jun 1971. Contract AT(04-3)-701. 88p. Dep. NTIS $7.50.

Declassified 5 Sep 1973.

Information is presented concerning the S8DR test, ZrH reactor engineering, thermoelectric converter development, fuel element and control element development, and fuel element materials evaluation. (DCC)

35225 (AI-AEC-13011) SNAP REACTOR PROGRAMS PROGRESS REPORT, MAY-JULY 1971. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Sep 1971. Contract AT(04-3)-701. 97p. Dep. NTIS $8.00.

Declassified 5 Sep 1973.

Information is presented concerning the S8DR test, SPF ZrH reactor engineering, thermoelectric converter development, fuel element and control element development, and fuel element materials evaluation. (DCC)

35226 (AN-924) NERVA RADIATION ENVIRONMENT FROM LIQUID HYDROGEN. Anno, G. H.; Witthaus, J. K. (Aerojet-General Corp., San Ramon, Calif. (USA)). Apr 1963. 71p. Dep. NTIS $6.75.

The radiation environment about the NERVA engine during operation has been computed previously but the reon computations do not include the scattered neutron radiation and secondary capture gamma radiation which may be present due to the liquid hydrogen propellant of the RIFT stage. The analyses performed to estimate the effect of the liquid hydrogen propellant on the radiation environment are described. (auth)

35227 (AN-1544) MINERVA: A NUCLEAR ROCKET STEADY STATE SYSTEMS ANALYSIS COMPUTER CODE. Burgess, A. B.; Snyder, H. J. (Aerojet-General Nucleonics, San Ramon, Calif. (USA)). Dec 1966. 89p. Dep. NTIS $7.50.

MINERVA is an IBM 7094 digital computer code, written in Fortran IV, for the steady state systems analysis of a rocket engine system of the NERVA type. The analysis is based on the representation of the individual system components by a set of coupled, non-linear algebraic and transcendental equations. The independent variables are selected and an initial value for all variables input into the code. The Newton-Raphson iterative solution technique is used by the code to determine a steady state operating condition of the system. The weight of system components and, if desired, a set of influence coefficients can then be calculated. On completion of the calculations, the code prints out a system map and a tabulation of calculated data. Individual component characteristics are represented in the code in the form of functions which have been mathematically fit to available component data. Coefficients of these functions are a part of the code input and are readily changed as component data is updated. If new component data requires that the form of the function be changed, this can also be accomplished by making simple changes and re-compiling several of the code subroutines. Explicit component characteristics, such as dimensions and fixed coefficients (e.g., energy deposition fractions), are input as a separate tabulation and are easily changed. The code determines hydrogen thermodynamic properties from the Los Alamos Laboratory property subroutines TABHP and TABTP. (auth)

35228 (ANS-90298B) DEVELOPMENT SPECIFICATION: MANDREL, GRAPHITE, NOZZLE EXTENSION, NERVA. (Aerojet Nuclear Systems Co., Azusa, Calif. (USA)). 12 Jan 1971. 22p. Dep. NTIS $4.25.

The design and fabrication requirements for special tooling identified as the Graphite Mandrel are established. This Mandrel will be used in the manufacture of the Nozzle Extension (N. E.) for the NERVA engine. (auth)

35229 (ANSC-F-PR06-A727) FLUIDIC PROGRAMMER I. R. AND D., FIRST YEAR PROGRESS REPORT. Felsing, G. W. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 79p. Dep. NTIS $7.00.

A program to demonstrate a NERVA engine fluidic programmer concept has been completed. A selected portion of the programmer that produces chamber-temperature and pressure-demand profiles from the analog integration of logically controlled input steps was designed. The circuit components, several of them unique, were evaluated; successfully employed in breadboard models; and later integrated into a single, improved-performance unit. A digital integration system was also developed should analog integrator drift problems remain unresolved. A theoretical analysis was developed to aid in miniaturization of circuit logic. The analysis accounted for engine operating conditions, contamination, manufacturing capabilities, and power consumption. The investigation indicates that a fluidic programmer is feasible. (auth)

35230 (ANSC-TER17-W389f) LOGARITHMIC FORCE FEEDBACK STUDY FOR TELEOPERATOR APPLICATIONS TO COMPUTER-AIDED TELEOPERATOR SYSTEMS. Research Suggestion. Openshaw, F. L. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Feb 1971. 26p. Dep. NTIS $4.50.

The objective of the proposed study is to evaluate and determine the criteria for application of the use of logarithmic force feedback for use in teleoperator systems having multiple degrees of freedom. A preliminary effort has shown the feasibility of extending a useful single range of force feedback by at least a factor of 10. This increase in range will be evaluated in terms of performance and exploitation of human adaptiveness. In addition, criteria for scaling and gain for the interrelated degrees of freedom will be generated for the general class of "anthropomorphic teleoperator systems". The results could then be used to determine the cost/benefit trade in incorporating logarithmic force feedback in future teleoperator systems, as well as forming the design criteria for scaling and gain specifications for these systems. (auth)

35231 (APEX-908(Pt.B)) XNJ140E NUCLEAR TURBOJET. Section 4. Reactor. Comprehensive Technical Report, General

Electric Direct-Air-Cycle, Aircraft Nuclear Propulsion Program. Layman, D. C. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 15 May 1962. Contract AT(11-1)-171. 252p. Dep. NTIS $15.75.

Declassified 12 Sep 1973.

The Aircraft Nuclear Propulsion Program of the General Electric Company is described. A comprehensive technical report of the design and development activities of the XNJ140E Project is presented. Included are a presentation of the design objectives and requirements, an engineering description of the XNJ140E-1 nuclear turbojet engine, supporting analytical design data and methods of calculation, and a brief review of three design studies preceding, and directly applicable to the XNJ140E program. 49 references. (auth)

35232 (BMI-X-10066) GUIDELINES FOR DEVELOPMENT OF A TEST DESIGN FOR FULL-FLOW TESTING OF THE NERVA PROPELLANT FEED SYSTEM IN A SIMULATED-USE NUCLEAR-RADIATION ENVIRONMENT. Drennan, J. E.; Mace, A. E.; Wyler, E. N. (Battelle Columbus Labs., Ohio (USA)). 26 Nov 1963. Contract W-7405-eng-92. 15p. Dep. NTIS $4.00.

In response to a request from SNPO, Battelle Memorial Institute has prepared a preliminary plan for testing the NERVA Propellant Feed System at the ASTR reactor i.e., under a radiation environment. Various objectives and requirements of the test are given. (LTN)

35233 (FZK-170-1) NERVA COMPONENTS IRRADIATION PROGRAM. Volume I. GTR Test 4. (General Dynamics/Fort Worth, Tex. (USA)). 19 Jul 1963. 303p. Dep. NTIS $18.25.

Various components proposed for use in the NERVA engine were subjected to radiation from the Ground Test Reactor (a swimming-pool type reactor) at the Nuclear Aerospace Research Facility (NARF). Some components were irradiated at ambient temperatures, some at 700°F, and some at cryogenic temperatures. Components in the latter category included accelerometers and LVDT's, pressure transducers, resistance thermometers, strain gages (WANL), and a control-drum bearing. The accelerometers and LVDT's were placed in one dewar, the rest in a second dewar. Liquid nitrogen was used as the cryogen. Problems in the use of liquid nitrogen arose early in the test. Detonations occurred in both dewars, making it necessary to continue the test with gaseous, rather than liquid, nitrogen. Temperatures were restricted to a low of −170°F. The detonations in the dewars damaged some of the components, signal leads, and dynamic test assemblies, so that it was difficult in some instances to determine the effects of radiation from the effect of the detonations. Observations made before, during, and after the irradiation are described below for each type of component. The results are summarized for each type of instrument. (auth)

35234 (FZK-170-2) NERVA COMPONENTS IRRADIATION PROGRAM. Volume II. ASTR Test 1. Crabtree, R. D.; Johnson, F. H. (General Dynamics/Fort Worth, Tex. (USA)). 9 Dec 1963. 158p. Dep. NTIS $11.00.

Mechanical components (valves, bearings, flange seal assembly) proposed for use in the NERVA engine were irradiated in the ASTR reactor operating at 10 Mw for 327 seconds. The testing was dynamic with LH_2 flowing through the bearings and most valves. The integrated neutron flux was (8.6 − 18) 10^{12} n/cm^2 and the gamma dose was (2.9−13)10^7 ergs/gm(C), depending on position. There was no apparent damage to the valves, but some corrosion occurred between the aluminum flange and the stainless steel coupling. The bearing test was stopped after 155 seconds because of overheating: some discoloration of the bearing components occurred. The items were returned to Aerojet-General Corp. for analysis. (LTN)

35235 (FZK-170-4) NERVA COMPONENTS IRRADIATION PROGRAM. Volume IV. GTR Test 7A. (General Dynamics/Fort Worth, Tex. (USA)). 20 Nov 1963. 208p. Dep. NTIS $13.50.

The third in the series of irradiation tests using the Ground Test Reactor at the Nuclear Aerospace Research Facility (NARF) to determine the effects of reactor radiation on candidate NERVA engine components was performed 21 through 26 August 1963. The test items included control drum actuator components, accelerometers, resistance thermometers, linear motion displacement transducers, thermocouples and connectors, strain gages, and pressure transducers−all of which were placed in dewars and submerged in liquid nitrogen (LN_2) during the irradiation. Two coaxial cables mounted in a container that served as a dummy fuel element were irradiated in the reactor core. These cables were cooled by a flow of nitrogen gas through the container. One cable and several H-Film samples were attached to the outside of the dewar at the north irradiation position and were irradiated at ambient temperature. The results of the test are described briefly. (auth)

35236 (FZK-170-5) NERVA COMPONENTS IRRADIATION PROGRAM. Volume V. ASTR Test 2. Laney, W. M.; Stanley, J. D. (General Dynamics/Fort Worth, Tex. (USA)). 17 Dec 1963. 106p. Dep. NTIS $8.50.

Bearings proposed for use in the turbopump assembly of the NERVA engine were irradiated in the ASTR reactor at 10 Mw. The bearings were installed in a tester and dynamically operated at 24,000 rpm for 300 seconds while liquid hydrogen flowed through the tester. The integrated neutron flux was (1.3 − 52) 10^{12} n/cm^2 and gamma dose (5 − 160)10^6 ergs/gm(C), depending on position. The tester performed satisfactorily and no external damage was discernible. It was returned to Aerojet-General Corp. for analysis. (LTN)

35237 (FZK-170-6) NERVA COMPONENTS IRRADIATION PROGRAM. Volume VI ASTR Test 3. Guinn, J. W.; Pou, C. G. (General Dynamics/Fort Worth, Tex. (USA)). 20 Dec 1963. 100p. Dep. NTIS $8.00.

Several mechanical components proposed for use in the NERVA engine were subjected to radiation from the Aerospace Systems Test Reactor. They consisted of three bearings to be used in a turbine pump assembly (TPA). The bearings were installed in a tester which was dynamically operated for 10 minutes at 24,000 rpm while liquid-hydrogen flowed through the tester. Reactor power was 10 Mw. The tester was exposed to integrated neutron fluxes ranging from 1.9×10^{12} to 9.3×10^{13} n/cm^2 (E > 2.9 MeV) and gamma doses ranging from 5.8×10^6 to 1.1×10^8 ergs/gm(C). The tester performed satisfactorily during the irradiation, and no external damage was discernible. The tester was returned to Aerojet-General Corporation for postirradiation analysis. (auth)

35238 (FZK-170-7) NERVA COMPONENTS IRRADIATION PROGRAM. Volume VII. GRT Test 9. Chappell, E. E.; Kunselman, J. S.; Green, A. R. (General Dynamics/Fort Worth, Tex. (USA)). 30 Dec 1963. 137p. Dep. NTIS $10.00.

Various electrical components (resistance thermometers, linear motion displacement transducers, strain gages, accelerometers, pressure transducers and actuator components were irradiated at LN_2 temperatures in the GTR reactor. The integrated neutron flux was (1 − 640)10^6 n/cm^2 and the gamma dose (1 − 3300)10^6 ergs/gm(C), depending on position. In most cases changes of 2−10 percent were encountered between pre and posttest results; a few items (specified) changed much more during the test but recovered to within some percent of pretest performance afterwards. (LTN)

35239 (FZK-170-8) NERVA COMPONENTS IRRADIATION PROGRAM. Volume 8. GTR Test 10. Evans, J. W.; McMillan, W. D. Jr.; Walton, M. B. (General Dynamics/Fort Worth, Tex. (USA)). 30 Dec 1963. 162p. Dep. NTIS $11.25.

Candidate NERVA engine components (pressure transducers, accelerometers, system amplifiers and actuators) were irradiated in the GTR reactor, which was operated at 3 Mw for 100 hours. Radiation dosage was (4 − 13)10^{15} n/cm^2 and (2.4 − 8.4)10^{10} ergs/gm(C) of gamma radiation; it varied with the location of the components. For the most part the radiation effects were not serious. Ceramic tube amplifiers became excessively noisy, and the magnetic amplifiers deteriorated rapidly toward the end of the test but recovered immediately after irradiation. (LTN)

35240 (FZK-184-1) NERVA COMPONENTS IRRADIATION PROGRAM. Volume I. GTR Test 11. Evans, J. W.; McMillan, W. D.; Palmer, E. E.; Spears, A. B. (General Dynamics/Fort Worth, Tex. (USA)). 15 May 1964. 132p. Dep. NTIS $9.75.

An experiment was performed utilizing the NARF Ground Test Reactor to determine the effects of combined reactor radiation and cryogenic (liquid nitrogen) temperatures on linear motion displacement transducers (LMDT's), WANL strain gages, developmental strain gages, dome end support ring sections, and cork board insulation. In general, the experimental design encompassed three prime objectives: To determine radiation rate (transient) effects on the electrical characteristics of the test items; to determine the effects of total radiation exposure on these characteristics; and to determine abilities to recover these electrical characteristics after removal from the radiation field. The results are described. (auth)

35241 (FZK-184-5) NERVA COMPONENTS IRRADIATION PROGRAM. Volume V. ASTR Tests 4, 4A, and 5. Guinn, J. W.; Pou, C. G.; Wachowski, J. S. (General Dynamics/Fort Worth, Tex. (USA)). 11 Feb 1965. 226p. Dep. NTIS $14.50.

Operational data on 3 irradiation tests in the ASTR reactor of turbopump bearings proposed for use in the NERVA engine are reported. The bearings were dynamically operated at 24,000 rpm with liquid hydrogen flowing through the tester and reactor

power at 10 Mw. The planned irradiation times were for 1 hour, but one test was terminated at 5 minutes because of a rapid temperature increase in one bearing. The bearings were returned to AGC for post irradiation analysis. (LTN)

35242 (FZK-184-6) NERVA COMPONENTS IRRADIATION PROGRAM. Volume VI. GTR Test 15. Burtnett, R. L.; Evans, J. W.; Stuart, L. P.; Walton, M. B. (General Dynamics/Fort Worth, Tex. (USA)). 19 Mar 1965. 144p. Dep. NTIS $10.25.

Instrumentation (cables, convectors, strain gages, resistance thermometers, thermocouples and pressure transducers) proposed for use in the NERVA engine were irradiated in the GTR reactor. Most of these items were subjected to an average integrated neutron flux of 1.12×10^{16} n/cm^2 and an average gamma dose of 6.9×10^{10} ergs/gm(C). Cable insulation resistances were sensitive to the cumulated dose but, in most cases, returned to pre-irradiation values after the test. This change in insulation resistance was also observed in strain gages (but, with one exception, the resistances remained greater than 25 megohms). No other significant change was observed. There was no change in the pressure transducers (except in one case where an open circuit developed). Resistance temperature transducers and thermocouples were exposed to higher radiation doses and developed temperature deviations of several degrees F, usually positive for the resistance thermometers and dependent on the material and changing through the test in different ways for the thermocouples. The percentage of instruments failing during the test was small: failures of cables and connectors during a shaking test after the irradiation were more extensive. (LTN)

35243 (FZK-310-1) NERVA IRRADIATION PROGRAM. Volume I. GTR Test 18, Components Test. Guinn, J. W.; Nelms, L. W. (General Dynamics/Fort Worth, Tex. (USA)). 31 Aug 1966. 92p. Dep. NTIS $7.75.

The fifteenth in the series of irradiation tests using the Ground Test Reactor at the Nuclear Aerospace Research Facility (NARF) to determine the effects of reactor radiation on candidate NERVA components and materials was concluded on 2 July 1966. The test item was resistance temperature transducers. A measurement of the conversion of parahydrogen to orthohydrogen was also made. The test conditions and subsequent results are described briefly. Twenth RTT's with various shielding configurations covering their platinum elements were irradiated while submerged in liquid hydrogen. They were exposed to integrated neutron fluxes ranging from 1.50×10^{16} to 1.92×10^{18} n/cm^2 (E > 2.9 MeV) and gamma doses ranging from 1.8×10^{11} to 2.3×10^{11} ergs/gm(C). A maximum of 3% conversion of parahydrogen to orthohydrogen was measured at the steady state. The conversion was observed to be related to nuclear radiation, and the mechanism appears to be associated with the liquid as well as the gas phase. (auth)

35244 (GA-8991) EFFECT OF COOLANT LOOP CONFIGURATION UPON THE RELIABILITY OF THERMIONIC REACTOR SYSTEMS. Heath, C. A. (Gulf General Atomic Co., San Diego, Calif. (USA)). 31 Mar 1969. Contract AT(04-3)-167. 50p. Dep. NTIS $5.50.

Declassified 3 Mar 1975.

The reliability of coolant schemes for thermionic reactors has been analyzed. The flashlight and unit-cell concepts, which both include internally-fueled thermionic fuel elements placed within the reactor core, have been considered. The unit-cell reactor design permits the connection of thermionic fuel elements in a series-parallel network with component redundancy and an increased system reliability. The use of multiple redundant cooling loops is also shown to improve system reliability provided that the reactor system will not be shut down by liquid metal leaks. The effect of liquid metal leaks in a reactor system has been examined. For the unit-cell reactor design using multiple cooling loops, it is shown that dc conduction electromagnetic pumps should not be placed in series with the thermionic reactor output. 5 references. (auth)

35245 (GEMP-357) DEVELOPMENT AND EVALUATION OF A 1000°C YTTRIUM HYDRIDE NEUTRON MODERATOR. Baxter, W. G.; Marshall, J. C.; VanHouten, G. R. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 16 Apr 1965. Contract AT(40-1)-2847. 37p. Dep. NTIS $5.00.

Declassified 21 Mar 1975.

An evaluation program on hydrided and clad Y-Cr has demonstrated the 10,000-hour thermal, dimensional, and metallurgical stability of this material. A total of 80 hydrided specimens was fabricated and evaluated in non-nuclear and reactor environments. Property measurements such as hydrogen retention, dimensional stability, and metallographic studies were conducted. 10 references. (auth)

35246 (GESR-2078(Vol. 1)) THERMIONIC REACTOR DESIGN REPORT. Volume I. Design Analysis and Summary. Hill, P. R.; Becker, R. A.; Gietzen, A. J.; Hobson, R. R.; Jaech, J. L.; Lloyd, W. R.; Sawyer, C. D.; Voorhees, B. G.; Wilkins, D. R. (General Electric Co., Pleasanton, Calif. (USA). Nuclear Thermionic Power Operation). 15 Oct 1966. Contract AT(04-3)-189. 453p. Dep. NTIS $25.75.

Declassified 31 Aug 1973.

The design considerations and status of the STAR-C nuclear thermionic reactor concept are presented. The reported thermionic reactor design analysis is part of a program directed toward the development of a nuclear thermionic fuel element and a compact thermionic reactor system under U. S. Atomic Energy Commission Contract No. AT(04-3)-189 Project Agreement No. 32. A summary of major design considerations for the TFE and thermionic reactor is presented. The reference reactor design is included. Alternate design configurations which were considered are summarized. Examples of the computer output data for the fuel element performance computer program, SCOPE, are included. The electrical reliability analysis techniques are described. (auth)

35247 (GESR-2118) DEVELOPMENT OF A SPACE THERMIONIC REACTOR POWER PLANT. Second Periodic Progress Report, November 1, 1968–February 28, 1969. (General Electric Co., Pleasanton, Calif. (USA). Nuclear Thermionic Power Operation). 1969. Contract AT(04-3)-771. 227p. Dep. NTIS $14.50.

Declassified 21 Mar 1975.

Information is presented concerning the fabrication and irradiation testing of materials for thermionic fuel elements, thermionic fuel element design, and thermionic reactor technology. (10 references) (DCC)

35248 (GESR-2122) DEVELOPMENT OF A SPACE THERMIONIC REACTOR POWER PLANT. Fourth Periodic Progress Report, July 1–October 31, 1969. (General Electric Co., Pleasanton, Calif. (USA). Vallecitos Nuclear Center). 1969. Contract AT(04-3)-771. 223p. Dep. NTIS $14.50.

Declassified 27 Mar 1975.

Information is presented concerning the development and testing of emitter materials, thermionic fuel element development, reactor experiment, and systems technology. (DCC)

35249 (GESR-2124) DEVELOPMENT OF A SPACE THERMIONIC REACTOR POWER PLANT. Fifth Periodic Progress Report, November 1, 1969–February 28, 1970. (General Electric Co., Pleasanton, Calif. (USA). Nuclear Thermionic Power Operation). 1970. Contract AT(04-3)-771. 210p. Dep. NTIS $13.50.

Declassified 26 Mar 1975.

Information is presented concerning the fabrication and irradiation testing of materials for thermionic fuel elements, thermionic fuel element design, thermionic reactor technology, TREX description, and reactor shielding and power control systems. 13 references. (DCC)

35250 (GTR-4) IRRADIATION TEST, PRELIMINARY REPORT. (General Dynamics/Fort Worth, Tex. (USA)). 12 May 1963. 140p. Dep. NTIS $10.00.

A preliminary report on the irradiation testing of NERVA instrumentation is presented. The instrumentation included neutron detectors, strain gages, transducers, accelerometers, and various electrical components. (JWR)

35251 (GTR-7A) IRRADIATION TEST, PRELIMINARY REPORT. (General Dynamics/Fort Worth, Tex. (USA)). 21 Aug 1963. 78p. Dep. NTIS $7.00.

Components (actuator components, accelerometers, transducers, resistance thermometers, linear motion displacement transducers, thermocouples, strain gages and cables) proposed for use in the NERVA engine were irradiated in the GTR reactor to 300 Mw-hr. The integrated neutron flux was $(7.4 - 60)\ 10^{15}$ n/cm^2 and the gamma dose $(5.2 - 19)10^{10}$ ergs/gm(C), depending on position; the cables received a dose several times higher. Extensive pretests during test and posttest data are given; they are not amenable to a simple summarization. (LTN)

35252 (GTR-12A) IRRADIATION TEST, PRELIMINARY REPORT. (General Dynamics/Fort Worth, Tex. (USA)). 24 Apr 1964. 44p. Dep. NTIS $5.25.

Instrumentation (resistance thermometers, strain gages, cables) proposed for use in the NERVA engine was irradiated in the GTR reactor for 150 Mw-hr. The integrated neutron flux was $(6.1 - 49)\ 10^{15}$ n/cm^2 and the gamma dose $(1.7 - 26)\ 10^{10}$ ergs/gm(C), depending on position. Some of the resistance thermometers failed. The insulation resistance of the cables was reduced by the irradiation, but remained at a high value.

The test of the strain gages was unsatisfactory because of failure of the test fixture. (LTN)

35253 (GTR-15) IRRADIATION TEST, PRELIMINARY REPORT. (General Dynamics/Fort Worth, Tex. (USA)). 16 Dec 1964. 36p. Dep. NTIS $5.00.

Instrumentation (strain gages, cables, thermocouples, resistance thermometers, transducers) proposed for use in the NERVA engine was irradiated in the GTR reactor to 300 Mw-hr. The cable insulation decreased during the test but with few exceptions remained at or above several megohms. In most cases it returned to the original high value after the test. For the most part the strain gages showed little damage. Some of the pressure transducers failed but most did not. Not all the results were available. (LTN)

35254 (LA-2897) RADIOCHEMICAL MEASUREMENTS ON KIWI-B4A. Sattizahn, J. E.; Wagner, G. F. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1963. Contract W-7405-ENG-36. 97p. Dep. NTIS $8.00.

Declassified 27 Aug 1973.

The techniques and results of radiochemical measurements associated with the KIWI-B4A reactor test of November 30, 1962, are described. Information is given on total fissions produced, radial distribution of fissions within the core, axial distribution of fissions along the length of fuel elements, and fission asymmetry near the periphery of the core. (auth)

35255 (LA-3185-MS) KIWI-B-4E-301 PRELIMINARY REPORT. Elder, M. (comp. and ed.). (Los Alamos Scientific Lab., N. Mex. (USA)). 30 Oct 1964. Contract W-7405-ENG-36. 348p. Dep. NTIS $20.50.

Declassified 29 Aug 1973.

The Kiwi-B-4E-301 full power test was performed on August 27, 1964. The reactor was held at full power for approximately 8 minutes before the available liquid hydrogen supply required shutdown. Peak power achieved during this period was approximately 937 MW (calculated thermal) with a maximum average fuel element temperature of 4300°R. The reactor was restarted on September 11, 1964, and run at full power for 2½ minutes. No significant malfunctions were observed in any of the components or systems during this time. Visual inspection of components and core elements at disassembly showed them to be in good condition. There were areas of local corrosion and a few broken elements; but from all indications, the reactor could have operated for a considerably longer time. The results of preliminary data analysis for Experimental Plan V and visual inspection of reactor disassembly are presented. (auth)

35256 (LA-3231) STATIC PHYSICS OF ROVER REACTORS. Mills, C. B. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1965. Contract W-7405-eng-36. 47p. Dep. NTIS $5.50.

Declassified 28 Aug 1973.

The current series of nuclear-powered rocket reactors are small, graphite-moderated, beryllium-reflected cylinders loaded with ^{235}U in such a way that the power distribution is roughly flat at high temperatures. Niobium protects the graphite during high-temperature operation. Boron is the shim and control material. Inasmuch as the temperature varies from very low in the reflector (200°R) to very high in the core (5000°R), the reactor assembly has relatively neutronically complex energy and space functions. The median energy for neutron absorption is 100 eV; thus, fast neutron transport, resonance absorption, and—because of the beryllium reflector—thermal neutron transport problems are all important. The data needed for high-temperature reactor design are critical ^{235}U fuel distribution and kinetic constants. Room-temperature experiments resulted in detailed structural data for experiments having several degrees of geometrical complexity. In turn, these data yielded criticality and structural material value coefficients that were compared with calculated values. These values included ^{235}U, graphite, niobium, and hydrogen as functions of position and fission density distribution. The variety of multigroup reactor physics techniques used to calculate static physics of the critical assemblies included numerical neutron transport, resonance integral, and thermalization codes for group-averaged cross sections and fast transport cross sections. The Rover reactor studies followed extensive analyses of critical assemblies to establish the overall effects of moderators and absorbers; and, thus, the integral results are expected to be relatively accurate. The results of Kiwi-B studies were partially repeated to compare the computed and experimental fission density distributions. The description of the Phoebus reactor and the results of reactivity distribution studies show that k_{eff} is approximately equal to 1.00 ± 0.005; that the computed fission density distribution is within the experimental uncertainty; and that some errors still remain in resonance integrals, as is shown by the comparison of computed and experimental material reactivity values. (auth)

35257 (LA-3464) PHOEBUS 2 ADD-ON AFTERHEATERS. Seale, R. L. (Los Alamos Scientific Lab., N. Mex. (USA)). 1 Sep 1965. Contract W-7405-ENG-36. 51p. Dep. NTIS $5.75.

Declassified 28 Aug 1973.

Computational studies have been carried out on afterheater systems consisting of uranium carbide-zirconium carbide sections of varying length added to an essentially standard Phoebus 2 reactor. This approach makes use of the present Phoebus 2 design so that major problem areas are confined to the afterheater itself. When combined with a Phoebus 2 graphite section at its nominal design conditions, a 22-inch add-on afterheater gives 5400°R exhaust gas with maximum fuel temperatures under 5700°R. The study shows that this afterheater concept is attractive provided the material is capable of operation at significantly higher temperatures than the present uranium-graphite matrix. (auth)

35258 (LA-3598-MS) QUARTERLY STATUS REPORT OF LASL ROVER PROGRAM FOR PERIOD ENDING AUGUST 31, 1966. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1966. Contract W-7405-eng-36. 149p. Dep. NTIS $10.50.

Declassified 29 Aug 1973.

35259 (LA-3649) FABRICATION OF INVAR WRAPPER ASSEMBLY FOR THE PHOEBUS-1B REACTOR. Erickson, W. C. (Los Alamos Scientific Lab., N. Mex. (USA)). 15 Nov 1966. Contract W-7405-ENG-36. 20p. Dep. NTIS $4.00.

Declassified 29 Aug 1973.

An improved wrapper for the periphery of the Phoebus-1B reactor core was required to reduce the graphite corrosion attributed to H_2 leakage from the exterior to the interior of the core. A wrapper design was established which divided the reactor periphery into six 60° sections, each consisting of four panels. The fabrication procedure was developed, and panels for two reactors were constructed by rubber forming Invar channels and joining them by Heliarc welding; the panels were joined by interlocking their sides. (auth)

35260 (LA-4344) LASL ROVER PROGRAM, QUARTERLY STATUS REPORT FOR PERIOD ENDING NOVEMBER 30, 1969. (Los Alamos Scientific Lab., N. Mex. (USA)). 31 Dec 1969. Contract W-7405-eng-36. 65p. Dep. NTIS $6.25.

Declassified 27 Nov 1973.

Work was continued on the analysis of PEWEE-1 reactor tests and on the design and fabrication of components for PEWEE-2. Fundamental work on graphite, fuel elements and the development of phase diagrams of the systems involved is reported. Some brazing developments occurred and various computer program development is discussed briefly. Test facility operations are reported and also some progress on miscellaneous projects. (LTN)

35261 (LIB/Trans-547) FREON TESTS FOR DETERMINING STEADY STATE CRITICAL HEAT FLUX IN A 36-ROD CLUSTER WITH PWR GEOMETRY. Fulfs, H.; von Minden, C. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). Dec 1974. Translation by L. Beattie of GKSS-74/E/24. 35p. Dep. NTIS (US Sales Only) $4.75.

In the framework of the thermohydraulic core analyses for the Nuclear Powered Ship project, freon tests were carried out in a 36 rod cluster to determine critical heat fluxes. The cluster consisted of two zones containing 16 to 20 uniformly heated rods. The geometry corresponded to the original dimensions of a ship's reactor, and test parameters were approximated to the equivalent water values. The freon 12 test data are presented in tables and diagrams and are converted to the equivalent water values with the widely used scaling factors of Stevens and Bouré. Critical heat fluxes are calculated in the core analysis program DYNAMIT using the W3 correlation customarily applied to PWR's. In a comparison it is shown that the mean error between the calculated values and experimental values converted according to Stevens and Bouré is 10 per cent, with the W3 correlation being conservative in general. (8 references) (auth)

35262 (LRP-21) NERVA MONTHLY LETTER REPORT, 27 FEBRUARY 1963–26 MARCH 1963. Peterson, J. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1963. 135p. Dep. NTIS $9.75.

This is the twenty-first monthly letter report describing LRP effort on the NERVA engine development program. It describes the progress of work on the CY 1962 program which was authorized to be carried over into CY 1963, and the progress of the CY 1963 program. (auth)

35263 (LRP-23) NERVA MONTHLY LETTER REPORT, 27 APRIL 1963–26 MAY 1963. Peterson, J. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 4 Jun 1963. 142p. Dep. NTIS $10.25.

The twenty-third monthly letter report describes Liquid Rocket Plant effort on the NERVA engine development program. (auth)

35264 (NJD-14) NERVA POLICY AND INTERFACE PROCEDURE GUIDE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1970. 148p. Dep. NTIS $10.50.

The Policy and Interface Procedure Guide sets forth specific procedures to be followed by Aerojet-General (AGC) and Westinghouse Electric Corporation (WEC) in the accomplishment of their mutual objectives and responsibilities under Prime Contract SNP-1 and Subcontract NP-1. As conditions and circumstances change, revisions to the Guide will be issued to reflect mutually approved amendments, deletions, or additions. (auth)

35265 (NSP-63-87) NERVA-RIFT THRUST VECTOR CONTROL/MECHANICAL/SHIELDING INTERFACE REVIEW MEETING. (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA). Space Programs Div.). 9 Jul 1963. 46p. Dep. NTIS $5.50.

Slides presented at a review meeting have been documented. They deal with NERVA and SATURN-VN characteristics (bending moments, loads, etc.), control requirements (through launch and separation), NERVA thrust structures, propellant feed system, propellant tank heating, and radiation doses, etc. (LTN)

35266 (NTO-A-0022) NERVA HEALTH AND SAFETY MANUAL. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 18 Jun 1965. 149p. Dep. NTIS $10.50.

Detailed health and safety procedures are given in this manual. They involve most aspects of occupational health and safety from the use of ladders, to driving permits, handling of hazardous chemicals and radioactive materials, fire and housekeeping and safety inspections, etc. Also, various medical examinations provided are discussed in some detail. (LTN)

35267 (NTO-I-0259) CHANNEL ENGINEERING AND DATA SYSTEM EVALUATION FOR NRX-A6. Final Issue. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 30 Aug 1967. 27p. Dep. NTIS $4.50.

Following the End-to-End Instrumentation Check and prior to Experimental Plan I, a complete data evaluation check will be made to obtain pre-calibration, run (or ambient) and post-calibration data on all channels. The data is to be processed the same as any test run data and will be used with this procedure to determine if each channel is producing valid end data in the calibration and run modes. The supporting documents used in setting up the data system will be cross checked to verify that measured, calculated, or computer produced values are in agreement with calibration data and the intent of the Measurement Requirements List. (auth)

35268 (NTO-I-0305) NRX-A6 SIDE-BY-SIDE PNEUMATIC ACTUATOR SYSTEM RECEIVING INSPECTION, INSTALLATION, AND CHECKOUT. Final Issue. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 16 Oct 1967. 22p. Dep. NTIS $4.25.

This procedure provides the necessary instructions for performing receiving inspection, installation and checkout of the NRX-A6 side-by-side pneumatic actuator system at the E-MAD building, NRDS. In addition, instructions are provided for the pre- and post-test electrical check of the actuators at test cell "C". (auth)

35269 (NTO-I-0398) SUPPORT OPERATIONAL REQUIREMENTS DOCUMENT. NRX-A6 Test Series. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 10 Nov 1967. 142p. Dep. NTIS $10.25.

Test system and facility operational requirements for the NRX-A6 Test Series to be conducted at the Test Cell "C" complex have been integrated into the Support Operational Requirements Document (SORD). Section 2.0 will serve as a guide for the NRX-A6 testing and the basis of the Control Room Operating Procedures to be used for Experimental Plans I, II, and III. The appropriate requirements of the Test Specification, the Test Prediction Report, Safety Evaluation Report, and Operating Limits Document for the NRX-A6 reactor are listed. Support operation and data requirements for the NRX-A6 Test Series are outlined. Administrative control of pretest and test operations is defined, and the various teams and their respective functions are enumerated. Special test systems are described, and the scope of the side-by-side system tests is given. Data recording, photographic, television, and other miscellaneous requirements necessary are specified. (auth)

35270 (NTO-M-2677) REACTIVITY METER. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 2 Mar 1965. 9p. Dep. NTIS $4.00.

The design and construction of the reactivity meter for NRX-A3 has been completed. The enclosed memo describes the circuit, defines the assumptions and limitations, and recommends an operating procedure for mapping control drum worth. (auth)

35271 (NTO-M-12863) XECF RDR RECORDING AND DISPLAY REQUIREMENTS. Final Issue. Wayne, W. D. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 28 Sep 1967. 73p. Dep. NTIS $6.75.

35272 (NTO-M-17153) NRX-A6 FACILITY EXPERIMENTAL PLAN I. Turner, R. D. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 8 Aug 1967. 34p. Dep. NTIS $4.75.

Facility Experimental Plan I (FEP-I) will check out the flow and auxiliary systems, perform startups and shutdowns, verify operating procedures and the operation of the controls and emergency systems necessary to test the NRX-A6 reactor. Also, FEP-I will be the first checkout of the operation of the GH_2 accumulator installed at the pump discharge for emergency shutdown of the LH_2 flow system. Simulated reactor programmed startups and emergency shutdowns will be performed, and frequency response data on the turbo-pump control systems will be obtained. (auth)

35273 (NTO-M-21896) TRANSMITTAL OF SEMI-MONTHLY PROGRESS REPORT. For the Period of April 1 – April 15, 1968. Wayne, W. D. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 25 Apr 1968. 28p. Dep. NTIS $4.50.

Numerous test facility modifications and progress in testing of reactors and of test facilities are reported. The reactors are PHOEBUS-2, XECF, XE-PRIME, and NRX-A6. (LTN)

35274 (NTO-R-0002) THREE-DAY REPORT. EP-IB NRX-A2 TEST SERIES. Flow Tests. Kemp, S. N. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 10 Sep 1964. 31p. Dep. NTIS $4.75.

Experimental Plan IB was the second test of the NRX-A2 Test Series. The operations completion included automatic reactor startups to 1 KW, ambient gaseous hydrogen flow test, and liquid hydrogen flow test. This test was completed on September 4, 1964 at the Test Cell "A" facilities of the Nuclear Rocket Development Station (NRDS), Jackass Flats, Nevada. The test was successfully completed and the test objectives were achieved. The total integrated power generated during this Experimental plan, based upon the fission chamber calibration obtained during EP-IA was approximately 0.7 Mw-sec. At the completion of this run a commercial power load dump was performed to verify that the required systems were on the critical power bus. This check was completed and no anomalies were noted. (auth)

35275 (NTO-R-0032) THREE-DAY REPORT FOR EXPERIMENTAL PLAN VI. Alternate Startup, Medium Power Test. NRX-A3 Test Series. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 3 Jun 1965. 69p. Dep. NTIS $6.50.

Experimental Plan VI was completed on May 28, 1965 at Test Cell "A" facilities of the Nuclear Rocket Development Station, Jackass Flats, Nevada. During the conduct of this Experimental Plan particular requirements of the NRX-A3 Test Specification, WANL-TNR-161, as pertains to Medium Power Mapping Tests were satisfied. The test consisted of a fixed drum startup from 1 MW to 35 MW by increasing LH_2 flow. After establishing a steady-state reference condition in Power Control, the 1000°R Tie Rod Exit Temperature Line, the 2500°R Chamber Temperature Line and the $1 Reactivity Feedback Line were mapped up to a maximum power level of 420 MW and a maximum LH_2 flow rate of 54 lb/sec. The Medium Power-Flow Mapping Test was followed by flow programmed fixed drum startup from a nominal 10 lb/sec to 46 lb/sec LH_2 flow rate. This was followed by a programmed flow reduction (fixed drum) to a nominal 20 lb/sec LH_2 flow rate. Control System frequency response measurements were then performed at a nominal power of 150 MW and a flow rate of 20 lb/sec. The total operating time during this test was approximately 43 minutes of which approximately seven minutes were at more than 400 MW. The total integrated power for this Experimental Plan was 4.3×10^5 MW-sec. (auth)

35276 (NTO-R-0047) NRX/EST FACILITY CHECKOUT REPORT. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 9 Nov 1965. 116p. Dep. NTIS $9.00.

Extensive modifications which were required to support NRX/EST testing have been made to Test Cell "A" and control point since the NRX-A3 series. In order to insure that the systems would operate properly and to evaluate performance characteristics, several facility checkout tests were conducted on the integrated control point–test cell complex. In addition to providing data for facility performance analysis, these checkouts enhanced the training of additional operating personnel for NERVA testing facilities. (auth)

35277 (NTO-R-0052) NRX/EST PRE-TEST REPORT. Harves, T. O. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 30 Dec 1965. 63p. Dep. NTIS $6.25.

The NRX/EST assembly operations phase began the first week of June with the installation of the Flow Straightener on to the NRX/EST Test Car (T-2) and was completed with the installation of the Privy Roof Mount Shield. The Test Assembly was transferred to Test Cell "A" on October 18, 1965. The Test/Test Car Mate-up and final pre-test preparations were completed by December 4, 1965. In general, the assembly work at the R-MAD Building and the mate-up and pre-test preparations work at Test Cell "A" was accomplished as planned without any major problems. (auth)

35278 (NTO-R-0067) THREE-DAY REPORT FOR EXPERIMENTAL PLAN IVA. Engine Duration Test No. 2, NRX/EST Test Series. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 31 Mar 1966. 61p. Dep. NTIS $6.25.

Experimental Plan IVA of the NRX-A4-EST Test Series was performed on March 25, 1966, at the Test Cell "A" facilities. The performance of the Test Assembly endurance run for 13.5 minutes at rated operational conditions was a significant accomplishment. The bootstrap start up was successfully carried out at a dewar pressure of 70 psia. During the startup ramp to rated conditions, holds were initiated at the 2000°R, 2700°R, and 3350°R chamber temperature points. Response measurements on the chamber pressure controller were initiated as planned. As the frequencies increased the system oscillations appeared to be excessive, thus the response measurement was terminated. The amplitude of the oscillations was reduced by a factor of two and the response measurements again initiated. These were immediately terminated because of the apparent excessive system oscillations. The system was then switched to pressure program control and the run continued. Considerable core material was lost during the full power run as reflected by the change in drum position between pre and post test measurements. Also, a considerable amount of core material in the form of beads were found downwind. The Test Cell A facility was found to be grossly contaminated. No piece of core elements were found. (auth)

35279 (NTO-R-0072) NRX-EST SITE TEST REPORT. (NERVA Test Operations, Jackass Flats, Nev. (USA)). [nd]. 130p. Dep. NTIS $9.50.

The NRX/EST Test Series was successfully conducted at the Test Cell "A" facilities of the Nuclear Rocket Development Station, between December 8, 1965 and March 25, 1966, inclusive, using an engine-type configuration Test Assembly. The most significant operations and accomplishments were: The first operation of a nuclear rocket engine system with the major engine components connected in the flight functional relationship; demonstration of system stability under a number of different control modes while operating over a broad area of the engine performance map; demonstration of multiple restart capabilities of the engine system; and demonstration of the endurance capability of the reactor and other engine components by operating at nominal rated conditions for approximately 30 minutes and at or above 1700°R chamber temperature conditions for approximately 100 minutes. In general, performance of the reactor and engine system was in accordance with pre-test predictions. Fuel element corrosion with the significant core reactivity loss (as shown by the high drum position) during the last Experimental Plan was more than predicted. During the conduct of the test series numerous anomalies occurred and unexpected system behaviors were encountered. None of these affected the successful performance of the tests, although several did cause some delays. The more significant anomalies and unexpected system behaviors were as follows: (1) Inability of the TPA to rotate because of freeze-of the TPA bearing; (2) Sluggish operation of PDV; (3) VV-1 and VV-2 freeze-up; (4) Failure of the TPCV actuator; (5) Inoperable PCV-41 system after shutdown; (6) Hydrogen burning within turbine exhaust stacks; (7) Spurious period scrams due to interaction with communication system; (8) Unstable actuation supply pressure to car valves; (9) Freeze-up of Control Drum #1 actuator line; and, (10) Presents of a bird on the core exit surface. All anomalies were investigated and the necessary corrective action taken to preclude re-occurrence. The last NRX/EST Experimental Plan, during which a significant amount of core material was lost from the reactor, resulted in the Test Cell "A" facilities being highly contaminated with radioactive materials. Considerable effort was required to decontaminate the facilities and reduce the radiation environment after the NRX/EST Test Series in preparation for the NRX-A5 Test Series. (auth)

35280 (NTO-R-0084) SITE TEST REPORT FOR THE NRX-A5 TEST SERIES. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 28 Jul 1966. 100p. Dep. NTIS $8.00.

The NRX-A5 Test Series was successfully conducted at the Test Cell "A" facilities between May 26 and June 23, 1966, inclusive. The most significant operations and accomplishments were: Test Assembly operation for 30.4 minutes at near rated conditions and for 35.3 minutes above 1900°R chamber temperature; demonstration of a new eight-decade neutronic system; checkout and operation of the reactor at rated conditions using a temperature control system without the neutronics power control as an inner loop; demonstration of the acceptability of a startup from low power to near rated conditions using hydrogen reactivity with drums in a fixed position; and attainment of initial criticality of the reactor after all poison wires were removed. (auth)

35281 (NTO-R-0120) FACILITY CHECKOUT REPORT FOR FEP-1 NRX-A6 TEST SERIES. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 14 Sep 1967. 127p. Dep. NTIS $9.50.

FEP-I of the NRX-A6 Facility Checkout Series was conducted on September 7, 1967, at Test Cell "C." The specific objectives were: To determine the adequacy of the GH_2 accumulator system pressurization and blowdown characteristics as required for NRX-A6; to perform B-15 valve mapping and LH_2 programmed startups to simulate NRX-A6 reactor operation; to perform frequency response tests on the LH_2 turbopump control systems and to determine the effect of the GH_2 accumulator system on the LH_2 flow system transfer function; to investigate the stability of turbopump operation at low flow rates; to perform Emergency Shutdown tests from the Intermediate, and Full Flow Program Holds with the LH_2 system accumulator and Dewar 3 on-line; to perform turbopump stall tests by stepping H-60 fully closed from the Intermediate and Full Flow Program Holds with the LH_2 accumulator and Dewar 3 on-line; to obtain reactor venturi (BF-13) correlation data with LH_2 and GN_2 flow; to operate the chilldown logic for the Dewar 3 system; and to perform a high flow GN_2 flow test through a simulated reactor impedance. Most of these objectives were achieved. (auth)

35282 (NTO-R-0123) FACILITY CHECKOUT REPORT FOR FEP-11. NRX-A6 Test Series, September 21, 1967. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 21 Sep 1967. 127p. Dep. NTIS $9.50.

FEP-II of the NRX-A6 Facility Checkout Series was conducted on September 21, 1967, at Test Cell "C". The specific objectives were: to perform frequency response tests on the turbo-pump RPM and LH_2 Flow Control Systems; to perform B-15 valve mapping and LH_2 programmed startups to simulate NRX-A6 operation; to investigate system stability during low flow operation of the turbo-pump; to investigate further the GH_2 accumulator effectiveness in attenuation of pressure oscillations which accompany Emergency Shutdown and stall of the turbo-pump; to perform an NRX-A6 profile run and simulated reactor cooldown operation using Dewar 3, the mixing chamber, and LN_2 systems; to obtain open loop transfer function measurements on the propellant feed system; and to perform Mark 25 turbo-pump mapping at 32,000 rpm and 25,000 rpm. The detailed results of the tests are given. (auth)

35283 (NTO-R-0126) FACILITY CHECKOUT REPORT FOR FEP-III NRX-A6 TEST SERIES. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 19 Oct 1967. 122p. Dep. NTIS $9.25.

FEP-III of the NRX-A6 Facility Checkout Series was conducted on October 19, 1967, at Test Cell "C." The objectives were: To perform a "green" run on the newly installed pump; to perform an NRX-A6 flow profile run, including simulated cooldown; to determine the final valve profile programs; to obtain additional data on the Dewar 3 system characteristics during chilldown and flow shutdown; to obtain additional data on the accumulator during flow system operation and shutdown; to perform frequency response tests on the LN_2 flow control system; and to obtain data on the effect of the TES on the main propellant line ringing during flow shutdown. All of the objectives of this experimental plan were successfully achieved. (auth)

35284 (NTO-R-0146) XECF SITE TEST REPORT. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 20 Jun 1968. 172p. Dep. NTIS $11.75.

The XECF (Experimental Engine Cold Flow) Test Series was performed at the Engine Test Stand #1 Facility, NRDS, during April 1968. XECF was considered to be a very successful program in that all primary objectives were met. The tests were quite useful to the facility because this was the first time that all of the facility subsystems at ETS-1 had been run together. System interactions, fluid usages, operational sequencing, etc. could thus be verified under actual conditions. An additional benefit was the large amount of operator training and experience acquired. (auth)

35285 (NTO-R-0176) PHOEBUS IIA EFFLUENT MEASUREMENTS. Final Issue. Smith, R. A. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 8 Jan 1969. 12p. Dep. NTIS $4.00.

Effluents and cloud samples of effluents collected by aeroplane from the PHOEBUS-2A test were examined by micrography and radiochemical analysis. Most of the debris consisted of graphite and a few ruptured fuel beads. There was little iodine fractionation, but a small amount of Tellurium-132, iodine-131 and barium-140 tended to migrate, so the amounts of these radionuclides were slightly lower than expected from the normal fission product distribution. Only micrographic and radiochemical results on the particulates examined are reported. (LTN)

35286 (NTO-R-0182) CONSOLIDATION OF NRX REACTOR FUEL ELEMENTS AND HARDWARE. Smith, R. A. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 28 Oct 1969. 76p. Dep. NTIS $7.00.

Three fuel storage flat cars (F-2, F-4, and F-8) were returned to the R-MAD Disassembly Bay for unloading and storage of radioactive materials, while necessary repairs and modifications were made on each car. During the period in which the reactor fuels from NRX-A2, NRX-A3, NRX-A4, NRX-A5 and NRX-A6 were stored in the R-MAD Building, efforts were conducted to measure the total amount of remaining fuel and consolidate it into the least number of storage containers. In addition, ten selected unfueled elements from each reactor, except NRX-A6, were stored for future examination. The remaining unfueled elements were placed into waste containers and buried in the R-MAD Radioactive Dump as classified irradiated waste. Also, the reactor hardware and components stored on the flat cars were assembled, itemized and placed in 55-gallon drums for long-term storage. A description and the results of each of these consolidation operations is given. (auth)

35287 (NUS-167) PARTICLE REENTRY INTERACTIONS. Decker, R. S. Jr.; Goldman, M. I. (NUS Corp., Washington, D. C. (USA)). 20 Jan 1964. 46p. Dep. NTIS $5.50.

The problems associated with the premature reentry of fragments of a high power density nuclear rocket reactor require continuing examination to determine the probabilities and magnitudes of radiological effects. Interaction probabilities are considered for four types of potential exposures: external whole body gamma doses, beta skin doses, lung and gastrointestinal tract doses. Particle size distributions and estimates of their distribution on the earth surface are based on APG-2 and LMSC data respectively, although for the size ranges of interest for the last three dose categories, extrapolations are required in both cases. Interaction effects are viewed in the light of additional information gained by further review of the literature, particularly for skin burn and GI tract exposures from external and internal sources. Particularly for the GI tract exposure, more work appears to be necessary to resolve questions of dose effects. Sufficient information appears to be available from weapons test data to bracket skin effects to a satisfactory extent. Similarly, the dosimetry and effects of particulate irradiation in the lung are reasonably well defined at present, and only slight improvements, if any, can be made. (auth)

35288 (NUS-203) FURTHER STUDIES ON FRAGMENT BEHAVIOR FOLLOWING A REACTOR EXPLOSIVE DESTRUCT. Firstenberg, H. (NUS Corp., Washington, D. C. (USA)). Nov 1964. 57p. Dep. NTIS $6.00.

Theory and some experiments (where graphite fuel rods were fragmented by chemical explosives) are considered from the point of view of developing and validating a model for the particle size distribution of the fragment and their velocity. The mass distribution followed a Poisson distribution. A speed function model ($Vo(X) = CX^{-m}$) was examined on log–log plots. From 20 to 50 percent of the explosive energy appeared to be converted to kinetic energy of the fragements. (LTN)

35289 (RN-66250(Vol.1)) SYNTHESIS OF CALCULATION METHODS FOR THE DESIGN AND ANALYSIS OF RADIATION SHIELDS FOR NUCLEAR ROCKET SYSTEMS. Volume I. Technical. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1966. 161p. Dep. NTIS $11.25.

This proposal is submitted in response to a Request for Proposal entitled: "Synthesis of Calculation Methods for the Design and Analysis of Radiation Shields for Nuclear Rocket Systems." The current methods used to predict radiation distributions about nuclear rocket and nuclear electrical systems are actually various combinations of shielding codes, each having inherent advantages and disadvantages. These codes evolved and were combined as a result of the immediate and pressing contractual requirements of past and current reactor programs without sufficient emphasis directed toward optimization of the methods on the basis of validity, efficiency, and cost. Use of these current prediction methods has resulted in numerous analytical difficulties. Aerojet recognizes the innate deficiencies of these current analytical methods and responds to the Marshall Space Flight Center's requirements for a comparison and critical evaluation of these methods by proposing a program for objectively screening, evaluating, and selecting prediction methods which will ensure that future calculation of radiation levels will be made quickly and accurately. (auth)

35290 (RN-71001C(Appx. B)(Suppl.)) STATEMENT OF WORK COVERING THE PERIOD OCTOBER 1, 1970–SEPTEMBER 30, 1972. Supplement A71/72C to Appendix B. (Aerojet-General Corp., Sacramento, Calif. (USA)). 18 Jun 1971. 144p. Dep. NTIS $10.25.

A statement of work defined the NERVA program projects, expected accomplishments and responsibilities for the period October, 1970, through September, 1972. The detailed statement was intended to ensure that the Company and the Government's contracting office had the same ideas about the work to be accomplished. (LTN)

35291 (RN-71008(Vol.1)(Rev.B)) PREFACE AND WORK STATEMENTS, OCTOBER 1, 1970–SEPTEMBER 30, 1972. Volume I. Revision B. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1971. 68p. Dep. NTIS $6.50.

35292 (RN-DR-0103(Vol. 2)(Appx. A)) NERVA ENGINE DEVELOPMENT PROGRAM PLAN. Appendix A to Volume II. Turbopump Optimization and Final Design. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1967. 66p. Dep. NTIS $6.50.

The turbine of the turbopump was first designed for a fixed engine operating point and then a parametric analysis was made for a range of engine operating conditions. The most significant variables for the turbine are the flow rate, number of stages, efficiency, pressure ratio, inlet temperature and pressure, shaft horsepower and blade speed. The details of optimizing turbine design to give the required performance at a reasonable weight and within the strength of materials are given. Then the pump part of the unit was subjected to a similar optimization. Due to the very low temperatures and two phase flow initially some unusual problems were encountered. (LTN)

35293 (RN-DR-0122) NERVA SUPPORT EQUIPMENT: OPERATING AND MAINTENANCE INSTRUCTIONS FOR TURBINE EXHAUST NOZZLE CLOSURE-4108. (Aerojet-General Corp., Sacramento, Calif. (USA)). Nov 1967. 16p. Dep. NTIS $4.00.

The Turbine Exhaust Nozzle Closure, Provisioning List Item 4108, is used in the E-MAD Building and ETS-1 at the Nuclear Rocket Development Station (NRDS) to complement other equipment in performing XE Engine Leak Checks after final assembly and prior to a test firing. This manual provides operating and maintenance instructions for the Turbine Exhaust Nozzle Closure. (auth)

35294 (RN-DR-0181A) DESIGN REQUIREMENT SHEETS FOR THE THRUST-STRUCTURE SUBSYSTEM, EC 90152. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 66p. Dep. NTIS $6.50.

The Design Requirements Sheets cover the Thrust Structure Subsystem, EC 90152, and its associated components as described in the NERVA Engine Specification Tree, AGC Drawing 1137101G. (auth)

35295 (RN-DR-0182A) DESIGN REQUIREMENT SHEETS FOR THE EXTERNAL-SHIELD SUBSYSTEM, EC 90243. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 25p. Dep. NTIS $4.25.

The Design Requirements Sheets cover the External Shield Subsystem, EC 90243, as described in the NERVA Engine Specification Tree, AGC Drawing 1137101G. (auth)

35296 (RN-DR-0185A) DESIGN REQUIREMENT SHEETS FOR THE NUCLEAR SUBSYSTEM, CP 677555. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 79p. Dep. NTIS $7.00.

The Design Requirements Sheets cover the Nuclear Subsystem, CP 677555, and Structural Support Coolant Valve as described in the NERVA Engine Specification Tree, AGC Drawing 1137101G. (auth)

35297 (RN-DR-702) SPEAR TEAM REPORT, XECF EP-2. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 11 Apr 1968. 277p. Dep. NTIS $17.00.

A major portion of the objectives for EP-II were successfully completed. The XECF Engine was smoothly bootstrapped with both a wet and dry pump, at a 35 psia tank pressure. The operating time to conduct the test was reduced about 50% from EP-I and consumption of critical gases was reduced with improved procedures. The LN_2 system, which was not used in EP-I, was activated and a successful switching from GHe to LN_2 in the cool-

down line was accomplished. Two of the three planned LH_2 insertion tests were conducted but the desired results were not obtained because of insufficient chilling in the liquid hydrogen transfer line. (auth)

35298 (RN-Q-0036) RELIABILITY AND QUALITY ASSURANCE SUPPLEMENT FOR FOURTH QUARTER, CY 1965. Supplement No. 36A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 31 Oct 1965. 79p. Dep. NTIS $7.00.

By consolidating requirements and eliminating unnecessary variability, the variety of specifications employed has been reduced, particularly for Dye Penetrant, Ultrasonic and X-ray procedures. This was a joint effort with engineering personnel in establishing (and making more realistic) acceptance rejection criteria. Product Assurance Engineering also was instrumental in obtaining cleaning specifications applicable to large hardware items such as nozzles, propellant feed lines, and pressure vessels. By these changes significant problem areas were minimized. A more positive control of procurement, fabrication, assembly, and testing quality operations was accomplished during CY '65. This was due to improved functional assignments, establishment of revised systems of control, and the continuous monitoring of the efforts applied. Positive callouts of all Supplier quality requirements, and greatly expanded use of surveillance and product verification at source, have led not only to improved quality but also to reduced costs. Improved definition of inspection requirements and the establishment of the specific data requirements and documentation retention have provided additional gains in the task of assuring quality. A major improvement in the definition and control of quality requirements for in-plant fabrication was accomplished by installation of an integrated planning system. Product Assurance and Manufacturing Engineering now jointly prepare shop-order planning, including quality requirements. This has provided improved communication of requirements and greater consistency in application, and has simplified the task of controlling the amount and level of inspection effort. Here again, the gain to the program was both in terms of improved assurance of quality and reduction in cost of operations. Product Assurance monitoring of major subcontractor and support equipment contractors has led to improved definition and compliance with quality requirements for fuel elements and other nuclear hardware. The associated end-item documentation requirements have been more adequately defined. Improved liaison with major subcontractors has reduced areas of disagreement and resulted in clarification of SNP-1 requirements. (auth)

35299 (RN-S-0510(Vol.2)) XE-PRIME ENGINE FINAL REPORT. Volume II. Assembly, Test, And Disassembly Operations. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 482p. Dep. NTIS $27.25.

The XE-Prime engine was the first nuclear rocket engine to be tested with components in a flight-type, close-coupled arrangement. The general objective of the test series was to further extend nuclear rocket technology in preparation for a flight system and to operate the test facility under nuclear firing conditions. A description of assembly, test, and disassembly operations is presented. (auth)

35300 (RN-S-0559) PROPULSION/ELECTRICAL POWER GENERATION (INCLUDING WANL PROJECT 495). Project 395. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 82p. Dep. NTIS $7.25.

The feasibility of utilizing the NERVA engine as a heat source for a 25-kW(e) electrical power system was investigated. A minimum number of changes to the NERVA engine to perform the dual function was an important ground rule. Several concepts for removing heat from the engine were evaluated in conjunction with dynamic power-conversion systems suitable for use with the temperatures available. For applications requiring long life, leakage of hydrogen gas from the primary coolant loop was identified as a problem area. An organic working fluid, thiophene, was selected as the most desirable fluid for the Rankine-cycle power-conversion system. The heat-rejection system utilizes gaseous hydrogen to conduct heat from the condenser to the exterior surface of the stage. A wick-type condenser was conceived for operation in a zero-gravity environment. The operating characteristics of the NERVA electrical system enhance the operation of the nuclear rocket engine by providing a radiative means for dissipation of decay thermal energy. Thus, cooldown requirements may be reduced by 50% and the cooldown flow (i.e., thrust) period reduced by 90%. (auth)

35301 (RN-TM-0210) NERVA TEST REPORT, DILUENT CONTROL VALVE (DCV) P/N 278100-59, S/N 014 LH_2 FLOW AND FUNCTIONAL TESTS. Betz, A. J.; Lundback, A. V. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Jul 1965. 12p. Dep. NTIS $4.00.

The results of a liquid hydrogen flow test of a NERVA Turbine Power Control Valve to confirm its acceptability for use as a Diluent Control Valve in the NERVA Engine System are presented. The valve was actuated during the test and valve disk differential pressures were recorded at various disk positions to establish a flow characteristic of the unit with liquid hydrogen. (auth)

35302 (RN-TM-0212) NERVA MARK III MOD 4 PUMP EFFECT OF BACKVANE FLOW ON PUMP EFFICIENCY. Nishioka, T. (Aerojet-General Corp., Sacramento, Calif. (USA)). 22 Sep 1965. 14p. Dep. NTIS $4.00.

Presented are results of tests conducted on the pump of the Mark III Mod 4 turbopump to determine the effect of backvane flow on pump efficiency. (auth)

35303 (RN-TM-0234) HOT BLEED VENT VALVE ASSEMBLY, ACCEPTANCE TEST REPORT. Lachnitt, F. G. (Aerojet-General Corp., Sacramento, Calif. (USA)). 2 Nov 1965. 44p. Dep. NTIS $5.25.

The results of a test on a candidate Hot Bleed Vent Valve Assembly (HBVVA) for the NRX/EST engine system are reported. The valve successfully completed the test, demonstrating functional adequacy during flow of hydrogen at 1150°R and 550 psig. It was accepted. (auth)

35304 (RN-TM-0291) NRX AND NRX/EST GIMBALED BELLOWS. Thomas, R. W.; Johnson, L. D. (Aerojet-General Corp., Sacramento, Calif. (USA)). 12 May 1966. 79p. Dep. NTIS $7.00.

The NRX-A and NRX/EST test assemblies have propellant lines which use four- and five-inch internally gimbaled bellows assemblies. During design review of the NRX/EST components, questions were raised regarding the acceptability of the bellows for the expected test environment. Data has been presented covering qualification testing, environmental testing experience obtained from NRX-A firings, nozzle and turbopump development tests, CFDTS and bellows component development and acceptance tests. After reviewing all the data and comparing it with the expected operational environment at NRDS, it has been concluded that the four-inch bellows in the NRX/EST turbine inlet line and the five-inch bellows in the NRX/EST pump discharge line and the NRX-A5 propellant feedline are acceptable. (auth)

35305 (RN-TM-0299) COLD FLOW DEVELOPMENT TEST SYSTEM (CFDTS) TEST SERIES II AND III DATA SUMMARY. Smyth, G. B. (Aerojet-General Corp., Sacramento, Calif. (USA)). 20 Dec 1965. 16p. Dep. NTIS $4.00.

This report briefly describes and summarizes the results of the second and third series of Cold Flow Development Test System tests conducted at Sacramento in October and November 1965. (auth)

35306 (RN-TM-0323) EVALUATION OF THE NRX-A3 PROPELLANT FEED LINE. Locke, R. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). 28 Feb 1966. 10p. Dep. NTIS $4.00.

The Propellant Feed Line Assembly S/N 003 is evaluated for its performance and integrity during NRX-A3. During these experimental plans the fluid pressures and temperatures attained were equivalent to those predicted. Examination of the assembly after completion of testing indicated that it had maintained its structural and leakage integrity throughout the test program. Therefore, it was concluded that the assembly performed satisfactorily. (auth)

35307 (RN-TM-0352) TEST SPECIFICATION FOR THE X-ENGINE REMOTE ASSEMBLY DESIGN AID (RADA). Shrade, F. (Aerojet-General Corp., Sacramento, Calif. (USA)). 10 May 1966. 11p. Dep. NTIS $4.00.

Specifications are given for testing remote handling equipment designed for repair, assembly, disassembly, etc. of the x-engines. It will also be used for training operating crews in remote handling operations. (LTN)

35308 (RN-TM-0354) NERVA INJECTOR DEVELOPMENT TEST SUMMARY FOR CONTRACT YEAR 1965. Wright, R. B. (Aerojet-General Corp., Sacramento, Calif. (USA)). 19 May 1966. Dep. NTIS $4.25.

The purpose of tests on three injector patterns was to demonstrate the capability of at least one pattern to operate in combustion tests at nuclear simulation conditions for the nozzle at a continuous duration of 100 seconds. Previous problem areas to be overcome were injector face erosion, injector baffle erosion, separation between copper face plates and stainless steel bands on copper face plate injectors and isolated cases of minor combustion instability. As a result of the tests it is concluded that the KAMT 51-1 injector pattern with copper face plates is satisfactory for repeated tests at conditions required for NERVA nozzle simulation. One injector with this pattern met the test

objective of 100 seconds continuous duration at nozzle nuclear simulation conditions. A second injector with this pattern was tested satisfactorily 22 times for a total duration of 316 seconds. (auth)

35309 (RP-MR-0007) PHOEBUS-2 MONTHLY PROGRESS REPORT FOR THE PERIOD OF 1 DECEMBER–31 DECEMBER 1965. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1966. 44p. Dep. NTIS $5.25.

Progress is reported related to nozzles (design, development, fabrication and testing) and to materials development (mechanical properties of special heats, heat treatments, and weldments of Hastelloy X). Some heat transfer experiments, other development and design effort, and testing are reported. (LTN)

35310 (RP-QR-0002) PHOEBUS-2 QUARTERLY REPORT FOR THE PERIOD OF 1 SEPTEMBER–30 NOVEMBER 1965. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1965. 183p. Dep. NTIS $12.25.

Heat transfer experiments on nozzles were carried out and are being analyzed. PHOEBUS-2 nozzles are being prepared for chemical simulation tests (LO_2/LH_2 combustion) of expected nuclear firing conditions. Alternative nozzles are being fabricated. Nozzle-pressure vessel interface stress analysis is continuing. Materials development and mechanical property determinations are proceeding for critical design problem areas (Hastelloy X, INOR-8, and Allvac 625). Development of welding methods for these and other materials is proceeding. (LTN)

35311 (RP-TM-0002) PHOEBUS-2. GH_2 Disposal System. Scale Burn Pond Test Program Presentation. (Aerojet-General Corp., Sacramento, Calif. (USA)). 5 Jan 1966. 43p. Dep. NTIS $5.25.

Slides and photographs of burn pond disposal systems for the safe disposal of hydrogen have been documented. (LTN)

35312 (RRA-T-708) MONTE CARLO CALCULATIONS OF GAMMA-RAY KERMA RATES IN NERVA PAYLOAD CONFIGURATIONS. Price, J. H.; Wells, M. B. (Radiation Research Associates, Inc., Fort Worth, Tex. (USA)). 1 Jun 1970. 74p. Dep. NTIS $6.75.

For Aerojet Nuclear Systems Co., Sacramento, CA.

FMC-G Monte Carlo calculations were performed to determine tissue kerma rates within the Modified Apollo, LM-B, and Mission C payloads in NERVA configurations containing 38,800 lb residual liquid hydrogen. The gamma-ray sources considered include the PVARA, skirt, and PDL. Results are presented in tabular form for each of fourteen energy groups as a function of radial position from the configuration center line. Each configuration was considered with and without an engine disk shield, and/or with and without a payload shield. Additional results were also determined at (1) the LH_2 tank bottom, (2) the 100,000-lb LH_2 level, and (3) the top of the LH_2 tank. Payload attenuation factors were also determined for each payload. The attenuation factors are defined as the ratio of the kerma rate within the payload to the kerma rate at the top of the LH_2 tank. These factors indicated a reduction in the kerma rate due to a payload as little as 19% for the LM-B and as large as a factor of 33 for the Modified Apollo with a payload shield. In addition to the above results, input source tapes for future FMC-G payload analysis calculations were generated. These source tapes represent the sources at the 100,000-lb residual LH_2 level. (auth)

35313 (RRA-T-710) MONTE CARLO CALCULATIONS OF GAMMA-RAY KERMA RATES IN NERVA PAYLOAD CONFIGURATIONS WITH EXTENDED PROPULSION MODULE. Warkentin, J. K.; Price, J. H.; Wells, M. B. (Radiation Research Associates, Inc., Fort Worth, Tex. (USA)). 1 Jul 1970. 119p. Dep. NTIS $9.00.

For Aerojet Nuclear Systems Co., Sacramento, CA.

FMC-G Monte Carlo calculations were performed to determine representative tissue kerma rate distributions at the tank top and at locations within the payload for various NERVA configurations employing a 300,000 lb LH_2 capacity tank. Kerma rates at the top of the tank were calculated for configurations containing 0, 7500, and 38,800 lbs residual LH_2. Kerma rate calculations at payload locations were made for the latter residual LH_2 quantity. The kerma rate calculations for payload locations were made for the Modified Apollo, LM-B, 264 in. Mission B, and 396 in. Mission B payload configurations. Kerma rate calculations for receivers located at the tank top and in the Modified Apollo and LM-B payloads included configurations with and without an engine disk shield and/or with and without a payload shield. Kerma rate results are presented in tabulated form for 14 energy groups as a function of the R, Z location of the detector regions. The gamma-ray sources used in the calculations included the PVARA, PDL, and nozzle assembly. Intermediate level source tapes, representing the distributions at the 100,000-lb LH_2 level for the various source configurations, were generated for use in future FMC-G payload analyses. An analytical expression was developed to estimate total kerma rates at the tank top for quantities of residual LH_2 other than those considered in the calculations. Attenuation factors, defined as the ratio of kerma rate at positions within the payloads to kerma rate at the tank top were determined for each source-payload configuration with 38,800 lbs residual LH_2 in the tank. (auth)

35314 (TCD-9660-005) U-TUBE NOZZLE TEST PLAN. Kawashige, C. M. (Aerojet-General Corp., Sacramento, Calif. (USA)). 3 Mar 1964. 17p. Dep. NTIS $4.00.

Declassified 13 Mar 1975.

The nozzles to be tested in this series are CRES 347 stainless steel jackets with CRES 347 U-shaped tubes brazed in place. Simulation firing with LO_2/LH_2 will be conducted to duplicate or exceed nuclear reactor firing conditions as part of the development program. These steel-jacketed nozzles are similar in configuration and operational concept to the aluminum-jacketed NRX-A nozzles but possess inherent advantages in fabrication and structural integrity. (auth)

35315 (TCR-9616-018(Pt.1)) PHASE II HEAT TRANSFER ANALYSES ON NERVA THRUST CHAMBER. Part I. Hester, J. N. (Aerojet-General Corp., Sacramento, Calif. (USA)). 29 Nov 1962. 93p. Dep. NTIS $7.75.

An analysis of the heat transfer characteristics of the NERVA thrust chamber occurring during its operation in a nuclear environment was undertaken to determine the following: A. The behavior of the nozzle jacket and the nozzle-to-pressure vessel flange attached to either an aluminum or a titanium pressure vessel. B. The behavior of the core support rib and the core support flange. C. The behavior of the fuel torus flange. D. The overall behavior of the thrust chamber assembly composed of the above mentioned components. The data presented on wall temperature distributions for steady state nuclear conditions indicate that the fuel torus flange is the only component that experiences heat transfer difficulties during exposure to nuclear radiation. The problem is attributed mainly to the unequal distribution of heat in relation to the location of the coolant. The lowest overall temperatures for the thrust chamber assembly attached to an aluminum pressure vessel were achieved with an 0.5 in. internal coolant manifold in the pressure vessel flange. In contrast, the lowest overall temperatures for the thrust chamber assembly attached to a titanium pressure vessel were obtained by relocating the external coolant torus around the pressure vessel and removing the internal coolant manifold. (auth)

35316 (TIC/SNM-5) REPORT ON THE NERVA SYSTEMS ANALYSIS PROGRAM UNDER SUBTASK 1.1.6. (Aerojet-General Corp., Azusa, Calif. (USA)). 10 Jul 1963. 36p. Dep. NTIS $5.00.

The systems analysis goals for the NERVA program are described and the program efforts to implement these goals are discussed briefly. The systems analysis program for the NERVA engine has an important role in the development of the engine to provide constraints, component interaction data, and criteria for the component development programs as well as the engine. An additional function of the analysis program is to provide feedback information from engine systems tests (CFDTS, NRX-A, PENTS, E-Engine) at a detailed level not possible at the component level. In this way the systems analysis program serves to evaluate the component development information and provide information to REON program management while at the same time providing both groups with the desired data on the progress of the program. The component development groups at WANL, LRP, and REON have the responsibility for the design, development, and testing of their specific component. In the process of this work, analyses of the component are made, compared with test data (usually different from end use conditions) and redesign of the component instituted. The component group therefore has the primary responsibility for establishing the performance data for each component. The Engine Integration group has the responsibility for coordination of the component groups design and fabrication efforts so that compatible engine hardware is assured. This group also formulates the engine test program objectives through the various component groups and the systems analysis group. The Systems Analysis group has the responsibility for determining the overall engine performance and operating maps to provide data on component constraints and interactions as an aid in the development of the components and engine. (auth)

35317 (TID-SNA-344) XE PRIME TEST REVIEW BOARD (TRB) (PHASE II). Changes to Documentation and Minutes of Meetings. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 1969. 460p. Dep. NTIS $26.00.

35318 (TID/SNA-346) TBD VALUES FOR ENGINE SPECIFICATION, NO. C002-CP-090290A-F1, 8 SEPTEMBER 1970. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 22 Jan 1971. 214p. Dep. NTIS $13.75.

35319 (TID/SNA-389) NERVA MANAGEMENT PLAN. Volume II. Logic Diagrams. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Dec 1970. 263p. Dep. NTIS $16.25.

Logic diagrams are provided that completely define the NERVA program functions, indicate the logical sequence of functions, etc. Constraining lines indicate that some degree of completion of the preceding function is necessary before work on the next function can be started. (LTN)

35320 (TID/SNA-392) USERS MANUAL FOR COHORT, A MONTE CARLO PROGRAM FOR CALCULATION OF RADIATION HEATING AND TRANSPORT ON THE IBM-360. Warkentin, J. K.; Price, J. H.; Wells, M. B. (Radiation Research Associates, Inc., Fort Worth, Tex. (USA)). 1 Oct 1970. 152p. Dep. NTIS $10.75.

For Aerojet-General Corp., Sacramento, CA.

The COHORT Monte Carlo procedure has been made operable on the IBM-360 computer system. Several modifications and additions to the procedure were made to increase its efficiency, flexibility, facility of use, and range of applicability to radiation heating and transport problems. Modifications included incorporation of (1) variable dimension capability; (2) new generalized geometry description routines whereby boundary ambiguity indices are computed automatically; and (3) capability for generation of restart source tapes for problem coupling applications. A routine was added to include capability for separate computation of the uncollided component of the average flux within a volume detector region. This document is intended to serve primarily as an instruction manual in the preparation of input data for applications of the COHORT procedure on the IBM 360 computer system. Basic computational techniques of the various COHORT routines are briefly described to assist the user in gaining an understanding of the methods involved and the use of input parameters and options. Instructions for preparation of card input data are presented in tabulated form for each routine. Input and output data for sample problems are included to illustrate application to an elementary case. (auth)

35321 (TID/SNA-405) TEST SPECIFICATION AND PROCEDURE REVIEW BOARD: CHANGES TO DOCUMENTATION AND MINUTES OF MEETINGS. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 8 Nov 1968. 437p. Dep. NTIS $25.00.

35322 (TID/SNA-418) NERVA SCHEMATIC BLOCK DIAGRAMS, S055-SS090205-F1. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1969. 23p. Dep NTIS $4.25.

Schematic Block Diagrams supplement the Systems Engineering data for Mission B as described in SNPO Technical Directive 69-14 dated 3 April 1969 and the June 1969 reference NERVA engine design depicted on AGC Drawing 1136339. The SBDs show pictorially the relation between the NERVA engine systems, subsystems, components, and vehicle systems. (auth)

35323 (TID/SNA-419) NERVA TIME LINE SHEETS, S056-SS090205-F1. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1969. 78p. Dep. NTIS $7.00.

Operations are planned and calculated from Mission B requirements and presented on Time Line Sheets by means of bar charts and pertinent commentary of first, second and third level functions of Blocks 1 and 2 beginning 9 seconds before liftoff and continuing through the third burn. (LTN)

35324 (TID/SNA-427) CONTRACT WORK STATEMENT. Supplement XXIV to Appendix B dated February 1, 1968. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. Contract SNP-1. 143p. Dep. NTIS $10.25.

A contract statement of the work to be performed between October 1, 1967 and September 30, 1968 is presented on a project by project basis. (LTN)

35325 (TID/SNA-431) NERVA ENGINE NATURAL ENVIRONMENT S023-CP-090290-F1. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 128p. Dep. NTIS $9.50

The NERVA engine shall be capable of rated operation after being subjected to all ground, launch, and flight environments. To achieve this capability, the process of developing engine design requirements must include an evaluation of all environmental factors which might affect engine operations and/or function. This document defines the natural environments to which the NERVA engine may be exposed, and by means of functional analysis develops in quantitative terms the environmental parameters to be considered in establishing engine design requirements. (auth)

35326 (TID/SNA-434) NERVA REFERENCE DATA (FULL FLOW ENGINE), S130-CP-090290-F1-PREL. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr. 1970. 325p. Dep. NTIS $19.25.

Data Item S-130 has been prepared under SNPO-C Contract SNP-1 to provide a means of distributing summary NERVA-engine information. The document describes the full-flow NERVA-engine and presents typical design and performance data in a common source. Mission descriptions, or reference missions, form the basis for which the NERVA engine is being designed. These missions call for a reusable nuclear engine to be used for the transfer of men or materials, or both, from earth orbit to lunar orbit and return, or to staging for deep-space injection and return. On the basis of reference-mission requirements, a reference engine has been defined with a description and performance data. (auth)

35327 (TID/SNA-439) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Engine, NERVA, 75K, Full Flow. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 136p. Dep. NTIS $10.00.

35328 (TID/SNA-440) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Engine, NERVA, 75K, Full Flow. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1971. 37p. Dep. NTIS $5.00.

35329 (TID/SNA-443) PRELIMINARY: MEASUREMENT REQUIREMENTS LIST FOR THE NERVA OPERATIONAL FLIGHT ENGINE (1137400E), C101-CP090290A-F1. Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Oct 1971. 53p. Dep. NTIS $5.75.

A preliminary Measurement Requirements List (MRL), Data Item C-101, is presented for the NERVA Operational Flight Engine, currently defined by drawing 1137400E. This update shows a decrease of the total engine measurement quantity from 542 to 348, improved definition of measurement criteria, reduction of measurement quantities, justification of measurement parameters and quantities and revisions consistent with changes in the Baseline Engine from 1137400C to 1137400E. (auth)

35330 (TID/SNA-444) RADIATION EFFECTS TEST PROGRAM PLAN: INSTRUMENTATION, COMPONENTS, AND ELECTRONICS. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jan 1972. 18p. Dep. NTIS $4.00.

35331 (TID/SNA-494) RELIABILITY ALLOCATIONS, ASSESSMENTS, AND ANALYSIS REPORT. Volume I. Reliability Model, Predictions and Allocations. Volume II. System Failure-Mode Effects and Criticality Analysis. Volume III. Trend Data. Duncan, D. S.; Bryan, W. M.; Witcraft, G. M.; Syrek, D (Aerojet-General Corp., Sacramento, Calif. (USA)). Sep 1971. 345p. Dep. NTIS $20.25.

The preliminary reliability analysis results for the 75K NERVA Full Flow Engine are reported, including allocations and predictions, system failure modes and effects, single failure points, models, and trend data. The analysis described is based on Flight Engine Flow Diagram 1137401, Revision F. A summary of the wear and deterioration trend characteristics that have been identified for the 400E NERVA engine is included. In addition to identifying trend characteristics, considerable progress was made in determining what possible monitoring techniques exist that could be applied or adapted to measure the progression of wear and deterioration in a flight engine. In the process of associating possible monitoring techniques with the identified trend mechanisms, it has become apparent that the interrelationship of trend monitoring to the engine controls, malfunction detection and pre-use checkout functions should have a significant role in determining the optimum type and quantity of instrumentation to be employed in a flight engine design. (auth)

35332 (TID/SNA-497) SYSTEMS ANALYSIS SUMMARY REPORT. Volume I. Sections 7-9. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1971. 240p. Dep. NTIS $15.00.

Some components have large sensitivity factors, the most important parameters are turbine and pump efficiency, turbine nozzle area, and nozzle tube and reflector temperature rise. These component variations individually can vary the turbine bypass flow rate by about one lb/sec. This is due to the fact that the turbine behaves as an amplifier in a full flow engine. Thus, turbine parameters and parameters affecting turbine inlet temperature have the greatest effect on the engine. Component design data for the 1137400E reference engine includes the specific input required for the Nuclear Engine Transient Analysis Program (NETAP) for performing the steady-state and transient analyses

required by the NERVA engine specifications. The component design data are also used as a basis for establishing the Common Analog Model (CAM) for the 1137400E engine. A brief description of other mathematical modeling programs is included. (auth)

35333 (TID/SNA-500) SYSTEMS ANALYSIS SUMMARY REPORT. Volume III. Flight Engine Profiles. Buden, D.; Guide, R. J.; Smalec, L. M. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Aug 1971. 471p. Dep. NTIS $26.75.

Flight engine profiles and pulse cooldown evaluations were run on 6 space missions. The computer printouts are incorporated. (LTN)

35334 (TID/SNA-506) FLIGHT SAFETY CONTINGENCY ANALYSIS REPORT. Volume II. Nonnuclear Subsystems Contingency Analysis. Kennedy, A. J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1971. 347p. Dep. NTIS $20.50.

A massive analysis of failure points and mechanisms of the nonnuclear subsystems of the NERVA flight engine recognizes that some types of failure are catastrophic (especially failures of most mechanical structures, pressure vessel, nozzle, etc.). Other types of failures can be tolerated (at some cost in increased propellant usage, etc.). Single failures of some of the more critical components (turbopumps, etc.) have been allowed for at some cost by redundancy in design. The nature of noncatastrophic failures, their consequences and their probability of occurrence is analyzed for each component, methods of detecting and identifying problems are given, and the nature of the contingency actions required are discussed. A second failure in the same subsystem is almost always far more serious than the first. (LTN)

35335 (TID/SNA-611) NERVA SAFETY PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 187p. Dep. NTIS $12.50.

The NERVA safety plan defines a total integrated approach to safety, including safety review, audit, and approval, as well as the application of safety-engineering principles throughout design, development, test, and operational phases of the system and its associated facilities and equipment. Consequently, this plan is concerned with both nuclear and nonnuclear hardware, manufacturing and assembly, handling and transport, ground test operations, space-vehicle launch, flight operations through ultimate disposal of the nuclear engine, and the effects of normal and abnormal flight operations on the world population. (auth)

35336 (TID/SNA-658) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR STRUCTURAL SUPPORT BLOCK VALVE AND ACTUATOR. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 13p. Dep. NTIS $4.00.

Part I of two parts.

This specification establishes the performance, design, test and qualification requirements identified as Structural Support Block Valve and Actuator (SSBV) consisting of a valve and an electro-mechanical actuator system. The SSBV assembly is to permit flow to the structural support assembly during engine operation and to permit flow to the pressure vessel reflector annulus during engine cooldown. (auth)

35337 (TID/SNA-659) PERFORMANCE/DESIGN AND QUALIFICATION REQUIREMENTS FOR TURBINE DISCHARGE CHECK VALVE. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 15 Dec 1969. 12p. Dep. NTIS $4.00.

Part I of two parts.

This specification establishes the performance, design, test and qualification requirements for equipment identified as Turbine Discharge Check Valve, (TDKV). The TDKV assembly is to prevent backflow to the turbine during engine malfunction operating mode. (auth)

35338 (TID/SNA-697) ENGINE SYSTEM TOLERANCES. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Oct 1969. 148p. Dep. NTIS $10.50.

The tolerance trade-offs to establish the allowable engine-to-engine variations have been determined as follows: (1) The functional requirements to maintain specific impulse at the minimum of 825 sec are met by the control system and measurements. (2) The minimum chamber-inlet temperature of 4500°R has been allowed to vary as a function of engine-to-engine variations from the nominal case. This was done to minimize the effect on core design since the mission is dependent on specific impulse and not directly on core-outlet conditions. Specific impulse is the parameter considered to be fundamental. If it is necessary to maintain a minimum chamber-inlet temperature of 4500°R, the variation in temperature could be increased. (3) It is recommended that the diluent-control valve presently in use in the system be removed. This recommendation is made because of the reduction of component variation or tolerances which results in less fluctuation of turbine-inlet temperature. It is now feasible to reduce turbine-inlet temperature to approximately 1596° and insure that the turbine-inlet limitation of 1710° is not exceeded. This will degrade nominal specific impulse by 0.34 sec which is reflected in chamber-temperature requirements. More importantly, this change will allow removal of a valve system and its associated controls and, therefore, will both improve reliability and lessen engine weight. (4) Chamber-temperature requirements of 4623°R may place a serious limitation on nuclear subsystem design. The present cycle has been nearly optimized. Therefore, cycle modification or changes in engine specifications are required to reduce the temperature if this is necessary. (auth)

35339 (TID/SNA-698) CONTROLS AND SIMULATION COMPUTER STUDY TO SUPPORT ENGINE AND REACTOR TESTING. For Inclusion as an Input to the Automatic Data Processing Long Range Plan. Kenyon, R. L. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 23 Dec 1970. 845p. Dep. NTIS $45.25.

The purpose of this study is to provide input to the ADP Long Range Plan to insure that controls computer requirements are properly traded off against other NERVA program computer requirements. The original ADP report excluded the controls computer and simulation computer requirements. These requirements were omitted under the premise that ANSC would deliver a flight qualified control system, including the computer, as a piece of equipment separate from the ADP computer. In recent discussions with SNPO, a philosophy has been adopted to defer the development of a flight qualified system, and to develop the control algorithms as well as conduct the tests at ETS-1 with a general purpose computer. Under the original ground rules, it was necessary to work with a configuration as close to the flight hardware as possible. The new ground rules (to use a commercial computer) delete the need to develop a highly reliable flight computer system and makes the controls input to the ADP plan significant. This study, conducted according to the ground rules listed includes the following: NERVA Controls Functional Requirements, Computer Functional Priorities, Functional Hardware Description, Control Computer Trade Matrix, Simulation at ETS-1/TCC, and Simulation Computer Trade Matrix. (auth)

35340 (TID/SNA-733) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Turbine Block Valve. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). [nd]. 64p. Dep. NTIS $6.25.

The TBV assembly, EC-90121B, consists of a valve, an electromechanical actuation mechanism, and an actuator driver; and is used in the turbopump assembly and valves module (TPA and valves module). There are two TPA and valves modules in the NERVA engine, each of which contains a TBV assembly installed in the turbine inlet line. The TBV assembly in the closed position blocks propellant flow in the turbine inlet line during all engine non-operating periods and during the cooldown period of engine operation. The TBV assembly responds to an opening command signal during the engine startup sequence and remains in the open position during engine startup, steady-state, and shutdown operation. During the engine shutdown sequence, the TBV assembly responds to a closing command signal and remains in the closed position until commanded to open. In the event of a required shutdown of a TPA and valves module, the TBV assembly associated with the TPA and valves module requiring shutdown responds to a closing command signal to block propellant flow in the turbine inlet line and remains in the closed position until commanded to open. The performance of the TBV assembly as installed in the TPA and valves module shall be within the limits and under the conditions specified herein. (auth)

35341 (TID/SNA-806) NERVA REQUIREMENTS ALLOCATION SHEETS. Book 1 of 2. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1969. 208p. Dep. NTIS $13.50.

Requirement Allocation Sheets are provided for Stage Elements, Assembly and Checkout of Stages and Payload, Assembly and Checkout of Launch Vehicle, Prelaunch Operations, Launch and Boost Operations, etc. (LTN)

35342 (TID/SNA-809) NERVA PRODUCT ASSURANCE PROGRAM PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA)). 30 Sep 1969. 70p. Dep. NTIS $6.50.

This plan describes the system used to assure the compliance with the quality requirements of the SNP-1 contract as described in Quality Program Provisions for Space Systems Contractors, NPC 200-2 and supplemented by the NERVA Program Requirements Document, SNPO-NPRD-1. The plan is structured to comply with the format of NPC 200-2 and with the applicable NPRD requirements. (auth)

35343 (TID/SNA-814) NERVA DETAIL SPECIFICATION. Part I. Performance/Design and Qualification Requirements for Engine, NERVA, 75K, Full Flow. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 1971. 133p. Dep. NTIS $9.75.

Detailed specifications are provided for the 75K, Full Flow NERVA engine as follows: Engine (CP-90290C), Ground Test Engine (CP-90290/10C), and Composite Core Engine (CP-90290/20C). (LTN)

35344 (TID/SNA-822) NERVA TEST SUPPORT EQUIPMENT AND AEROSPACE GROUND EQUIPMENT PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1970. 70p. Dep. NTIS $6.50.

35345 (TID/SNA-825) NERVA CHECKOUT AGE PRELIMINARY DESIGN PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Feb 1970. 54p. Dep. NTIS $5.75.

A philosophy for design, selection, or purchase of equipment for checking out the 75K, Full Flow NERVA engine is developed, so that qualified equipment will be available when needed. The equipment is to provide for the complete electrical and functional checkout of the engine and its subsystems, assemblies and components. The checkout equipment concept will be modular, based on commercially available equipment, be provided at minimum cost without compromising reliability or function, etc. (LTN)

35346 (TID/SNA-841) TRADE STUDY REPORT. Preliminary. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). Sep 1968. 332p. Dep. NTIS $19.75.

Trade study reports are included as follows: NERVA Mass Properties Status; 75K NERVA Engine Steady State Values at 100%, 57.7% and 20% Thrust; Mass Quality of LH_2 at NERVA Turbopump Inlet; Propellant Tank Pressurization Requirements for One-Way Synchronous Orbit Mission; Thrust Nulling; NERVA Engine Controllability During Startup and Propellant Consumption During Shutdown/Cooldown; Components Performance/Design Characteristics; Mission Input for NERVA Environmental Definition; 75K NERVA Engine Design Point Tolerance Investigation; Report on NERVA Engine/Tank Close-Coupling in ETS-1; Back Pressure Requirements for NERVA Engine Test Facilities; and Systems Analysis of NERVA LH_2 Topping Modification to ETS-1. (auth)

35347 (TID/SNA-896) MEMORANDA AND SUPPORTING DOCUMENTATION FOR NERVA DEVELOPMENT. Warman, E. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 26 Oct 1970. 455p. Dep. NTIS $25.75.

Several reports of various computer calculations of NERVA work on shielding, radiation heating, and neutron and radiation transport have been documented in one item. (LTN)

35348 (TID/SNA-898) PRELIMINARY SYSTEM SAFETY ANALYSIS REPORT FOR NERVA ENGINE TEST SYSTEM (CHAPTERS 1-5), s019-SAR002-W241a7. Draft. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Sep 1970. 77p. Dep. NTIS $7.00.

Safety in the planned testing of 75K, Full Flow NERVA engines is reviewed. The Nevada test facilities are described (with planned changes). Organizational functions and responsibilities are defined. (Due to the cancellation of the program the tests never took place.) (LTN)

35349 (TID/SNA-899) NERVA LOGISTICS SUPPORT PLAN, L003-SS-09205-F1. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 30 Sep 1969. 43p. Dep. NTIS $5.25.

The purpose of this plan is to identify the actions required for logistics support to ensure that the NERVA engine is maintained, provisioned and transported in accordance with the requirements of the NERVA-engine program and the logistics provisions of SNPO-NPRD-1. This plan delineates the philosophy of the NERVA-engine logistics program and facilitates integration of the NERVA-engine program into the overall NERVA program through mission completion. (auth)

35350 (TID/SNA-900) NERVA PRODUCT ASSURANCE PROGRAM PLAN, P017-SS-090205-F1. (Aerojet-General Corp., Sacramento, Calif. (USA). Nuclear Div.). 30 Sep 1969. 70p. Dep. NTIS $6.50.

This plan describes the system used to assure the compliance with the quality requirements of SNP-1 contract as described in Quality Program Provisions for Space Systems Contractors, NPC 200-2 and supplemented by the NERVA Program Requirements Document, SNPO-NPRD-1. (auth)

35351 (TID/SNA-912) PROJECT REPORT: SPECIFICATION REQUIREMENT ALLOCATION SHEETS (SRAs). (Aerojet-General Corp., Sacramento, Calif. (USA)). 16 Mar 1971. 496p. Dep. NTIS $28.00.

Specification Requirement Allocation Sheets have been prepared for the 75K, Full Flow NERVA engine (A Revision) as follows: Turbopump Assembly (EC-90149); Pressure Vessel and Closure (EC-90154); Nozzle Assembly (EC-90196); Structural Support Coolant Valve (EC-90192); Structural Support Block Value and Actuator (EC-90261); Pump Discarge Check Valves and Actuator (EC-90246); Bypass Control Valve and Actuator (EC-90122); Turbine Discharge Block Valve and Actuator (EC-90281); and Pump Discharge Control Valve and Actuator. (LTN)

35352 (TID/SNA-981) ENGINEERING OPERATIONS REPORT: SHIELDING REQUIREMENTS FOR RNS NUCLEAR PROPULSION MODULE. Warman, E. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 14 Jul 1971. 15p. Dep. NTIS $4.00.

The first phase of evaluation of the radiation analysis and shielding requirements for a modular Reusable Nuclear Shuttle (RNS) configuration employing a Propulsion Module is reported. This is based on extrapolations from previous ANSC computer analyses involving the McDonnell Douglas small propellant tank. The second phase is to include a computer analysis to confirm the extrapolations. This activity is in support of the evaluation of the propulsion module concept compatible with EOS launch contraints. In summary, it was found that an external engine disk shield is required for the modular RNS. The weight of this shield depends on the dose criterion and amount of residual LH_2 for cooldown. McDonnell Douglas and ANSC analyses differ considerably in the weight required. (auth)

35353 (TID/SNA-983) ENGINEERING OPERATIONS MEETING REPORT: ENGINE DESIGN AND ANALYSIS DEPARTMENT. DaVolio, J. R.; Unmack, K. E. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 8 Oct 1971. 21p. Dep. NTIS $4.25.

Engineering activities on a propulsion module are reviewed. Most of the discussion centered on some truss designs, electronics location, thrust vector control, and gimbaling, etc. (LTN)

35354 (TID/SNA-985) ENGINEERING OPERATIONS REPORT: I AND C SYSTEM COMPONENT DESCRIPTION AND INTERFACE DEFINITION. Porter, L. K. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 15 Jul 1971. 35p. Dep. NTIS $4.75.

Interface definitions and component descriptions were prepared using flow charts of data and control functions from the sensors through the computers and actuators. Component block diagrams within the flow charts were identified and are functionally described along with the interface data required to interconnect the components into a system. Following is a summary of component descriptions. Engine sensors (control, trend or malfunction detection); data acquisition system, (conditioning and sampling); data control unit (Raw data is received from the data acquisition system and, after reformatting, is passed on to the control computer for verification and use in control system calculations); control computer (input-output processors, central processor registers, interrupts, timing, speed and memory); stage/vehicle/engine interface unit (between the vehicle data bus and the control computer); actuator drivers (to provide the format and power to drive the engine control actuators when a signal from the control system is received); power distribution unit (power load selection process when queued by the data control unit); harness assembly; and the software (executive, data acquisition, calculations, controls, outside communications, system check and simulation). The maturity level of the Measurements Requirements List is a constraining factor in developing detail component descriptions in that system bandwidth is a function of the number and types of measurements and control functions required. (auth)

35355 (TID/SNA-986) I AND C SYSTEM ELECTRICAL INTERFACE NETWORK DESIGN STUDY. Huffman, R. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 9 Nov 1971. 13p. Dep. NTIS $4.00.

Three basic configurations of engine actuated element(s) electrical interfaces were studied. The primary difference between the three configurations selected for investigation was the form of actuated element position transducer interfaces. For the three cases, a tabulation of circuit connection points to engine actuated elements was generated. As the report indicates, a clear cut decision for selection of the optimum actuator electrical interface configuration cannot be made at this juncture. Accordingly, the following configuration, which is in general accord with the October 1971 issue of the MRL, is established (Case III) for purposes of the reference I & C electrical interface design: The engine control valve actuators utilize 12 bit shaft position encoders with the exception of the SSCV's, which along with the drums, incorporate position potentiometers. The gimbal pivot uses position potentiometers, while the purge valves have position switches.

All engine block valves incorporate position switches, one set at each end of travel. All of the foregoing position indications are of the triple redundant form. (auth)

35356 (TID/SNA-988) ENGINEERING OPERATIONS TRIP REPORT. Warman, E. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 11 Jun 1971. 3p. Dep. NTIS $4.00.

Results of a meeting disclose different results in computing radiation doses by different companies, and therefore, also in the amount of shielding required for NERVA. The different methods of calculation are discussed briefly. (LTN)

35357 (TID/SNA-1028) SEMIMONTHLY PROGRESS REPORT, 16 APRIL–30 APRIL 1968. (Los Alamos Scientific Lab., N. Mex. (USA)). 1968. 24p. Dep. NTIS $4.25.

Miscellaneous results are reported from the PHOEBUS-2A test. Other test facility operations are summarized. (LTN)

35358 (TID/SNA-1034) SEMIMONTHLY PROGRESS REPORT, 1 MAY–16 MAY 1968. (Los Alamos Scientific Lab., N. Mex. (USA)). 1968. 22p. Dep. NTIS $4.00.

Test facility operations are summarized. Health, Safety and Product Assurance are treated briefly. (LTN)

35359 (TID/SNA-1037) SEMI-MONTHLY PROGRESS REPORT, 16 MAY–31 MAY 1968. (NERVA Test Operations, Jackass Flats, Nev. (USA)). May 1968. 25p. Dep. NTIS $4.25.

Modifications of the various test facilities are reported. Hazard and safety evaluations were made, including several tests of safety equipment. Experimental plans I and II of the PHOEBUS-2A Reactor test series were completed. XE-Prime progress is reported and post-operative examination of NRX-A6 instrumentation is underway. (LTN)

35360 (TID/SNA-1040) NERVA ADHESION TEST. Semi-Annual Report. Aldrich, R. G. (Syracuse Univ. Research Inst., Syracuse, N. Y. (USA)). Dec 1967. 23p. Dep. NTIS $4.25.

The development of an adhesion test, in which cleaned, degassed metal wire surfaces are contacted at loads of 25 to 100 g, is described. Adhesion was lost by exposure to 70 torr hydrogen or 10^{-6} torr oxygen, but was restored by reevaluation. (LTN)

35361 (TID/SNA-1041) XECF ENGINE DISASSEMBLY. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 22 Jul 1968. 21p. Dep. NTIS $4.25.

The disassembly and post test examination of the XECF engine are to be conducted under clean area conditions with purge till disassembly. Any damaged components are to be photographed. Special efforts are required to prevent damage during disassembly. Notations are to be made of material discrepancies noted. Then all components are to be stored for possible future use. (LTN)

35362 (TID/SNA-1090) SUMMARY OF ENGINE DESIGN AND ANALYTICAL STUDIES TO MATURE THE 1137400E ENGINE BASELINE. Project 110, Paragraph 3. Kleinert, D. E.; Lester, W. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). May 1972. 31p. Dep. NTIS $4.75.

Engine Design and Analytical Studies Performed to Advance the Maturity of the 1137400E Flight Engine Baseline are presented. This included the packaging of numerous related components into integral, module arrangements compatible with engine design requirements. Secondly, this activity coordinated the applied mechanics and thermal analysis effort related to engine design. Remaining activity was the conceptual design study for a propulsion module. The "E" Revision drawing successfully incorporated the redesigned modules and revised components. Bellows were deleted from all lines except the propellant inlet lines, the cool-down line and the stage tank pressurization line in the region of the gimbal plane and the pump discharge line. While significant improvements to the engine assembly have been realized from this update activity, it is strongly recommended that further efforts be conducted in the areas of component and module support design. Also the maintainability of the critical components could be improved. (auth)

35363 (TID/SNA-1091) ENGINEERING OPERATIONS REPORT: MISSION PERFORMANCE SUMMARY AND APPLICABILITY OF 400E TECHNOLOGY TO SMALL ENGINE. DaVolio, J. R. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1972. 77p. Dep. NTIS $7.00.

Mission analysis activities conducted during Contract Year 1971–72 are summarized. They consisted of investigations of the effects of propellant shutoff valve leakage (PSOV), engine conditioning (chilldown) and single turbopump operation (1 TPA) at zero net positive suction pressure (0 NPSP) on mission performance and engine design as well as determining the applicability of the 400E technology for a "small" engine. Typical NERVA reference lunar missions as defined in the latest edition of the NPRD (Change No. 14) and the engine specification (CP-90290C, 8-71) were used for the various evaluations. In addition, hypothetical round trip Mars "opposition" and "conjunction" missions as defined in LMSC-A984555 were used as necessary to evaluate the 400E NERVA engine design. (auth)

35364 (TID/SNA-1096) ENGINEERING OPERATIONS REPORT: NERVA 400E THRUST TRAIN DYNAMIC ANALYSIS. Vronay, D. F. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 14 Apr 1972. 192p. Dep. NTIS $12.75.

The natural frequencies and dynamic responses of the NERVA 400E engine thrust train were determined for Nuclear Space Operations (NSO), and Earth-Orbital Shuttle (EOS) during launch and boost conditions. For NSO, a "mini-tank" configuration was analyzed with the forward end of the upper truss assumed fixed at the stage/mini-tank interface. For EOS, both a mini-tank and an "engine only" configuration were analyzed for a specific Engine Assembly Support (EAS) stiffness. For all cases the effect of the shield on dynamic response characteristics was determined by performing parallel analyses with and without the shield. Gimbaling loads were not generated as that effort was scheduled after the termination date. The analysis, while demonstrating the adequacy of the engine design, revealed serious deficiencies in the EAS. Responses at the unsupported ends of the engine are excessive. Responses at the nuclear subsystem interface appear acceptable. It is recommended that additional analysis and design effort be expended upon the EAS to ensure that all engine responses stay within reasonable bounds. In particular, the inclusion of damping in the EAS should be given careful consideration in all future designs. Supports at the ends of the engine appear necessary during launch. (auth)

35365 (TID/SNA-1115) TECHNICAL DIRECTIVES AND CHANGE ORDERS FROM SNPO TO THE CONTRACTOR. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 19 Oct 1970. 198p. Dep. NTIS $13.00.

35366 (TID/SNA-1127) ENGINE/COMPONENT DESIGN STATUS REVIEW ACTION ITEMS AND COMMENTS. Schroeder, R. W. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 27 May 1971. 6p. Dep. NTIS $4.00.

35367 (TID/SNA-1129) INTERFACE CONTROL METHOD STUDY. [nd]. 18p. Dep. NTIS $4.00.

The initial study was limited to interfaces between nonnuclear NERVA components, since these interfaces were the most controversial. Later phases of the study included all types of NERVA program hardware interfaces. The study was concluded by informal approval of a selected interface control method by managers of Sections N8150, N8610, N8630 and N8640 and Departments N8300, N8400 and N8500. (auth)

35368 (TID/SNA-1130) PREPARATION OF MRL C101B. DaVolio, J. R. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 11 Jan 1972. 11p. Dep. NTIS $4.00.

Plans are made for an update of Data Item C101-CP090290A-F1, Preliminary Measurement Requirements List for the NERVA Operational Flight Engine. The nature of the revisions and the schedules are specified. Also organizational responsibility is assigned. (LTN)

35369 (TID/SNA-1135) NERVA FLIGHT INSTRUMENTATION. Edlebeck, N. A. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 29 Dec 1971. 8p. Dep. NTIS $4.00.

The Measurements Requirements List appears to provide inadequate instrumentation to determine turbopump performance and trend data as required by the turbopump specification. The MRL should reflect the instrumentation presented in other References which are given. Pump and turbine performance need to be evaluated automatically in real time during the flight. This will require development of specialized electronic circuits but is not beyond the present state-of-the-art. Multiple independent parameters need to be utilized to provide a dependent parameter prediction for comparison to the actual measurement. (auth)

35370 (TID/SNA-1146) REVISED INTERNAL LEAKAGE RATES ALLOWABLE FOR 1137400/Rev. E REFERENCE ENGINE VALVES. Johnson, L. D. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 11 May 1971. 3p. Dep. NTIS $4.00.

Allowable internal leakage rates for the NERVA 400-E engine valves are reported. (JWR)

35371 (TID/SNA-1150) ENGINEERING OPERATIONS REPORT: PRELIMINARY GUIDELINES FOR ENGINE CONDITIONS DURING PROPELLANT SETTLING, PROJECT 100, WORK STATEMENT 6f. Altseimer, J. H. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). 30 Aug 1971. 15p. Dep. NTIS $4.00.

Stage propellant settling requires a very gentle initial acceleration of the order of 10^{-5} to 10^{-4} g's. This prevents excessive propellant geysering, bubble formation, sloshing and other erratic motions which can easily take place in low gravity fields. After the propellant is grossly oriented at the tank aft end, higher acceleration levels are needed to dissipate sloshing, bubbles and turbulences which might affect the propellant outflow. Thus, McDonnell Douglas recommends the use of a 3.15 lb thrust during the initial settling phase followed by the engine thrust buildup. Initial settling times as long as 3500 seconds are possible. It appears that NERVA could accomplish settling more efficiently and it is recommended that NERVA engine requirements be established to provide the low thrust settling impulses. This could be considered as operating in the low thrust end of the Idle Mode. Also, the hydrogen being used for settling should be integrated with the engine chilldown operations. The "tank pressure, restricted flow" chilldown mode results in flow rates and times which are comparable to those required for settling and the addition of settling requirements favors the selection of that mode for engine chilldown. (auth)

35372 (TID/SNA-1152) NERVA RELIABILITY AND QUALITY ASSURANCE PROGRAM PLANS. Part I. NERVA Reliability Program Plan. Part II. NERVA Quality Program Plan. Part III. Addenda. Veit, N. J. (Bendix Corp., South Bend, Ind. (USA). Bendix Products Aerospace Div.). 30 Aug 1963. 138p. Dep. NTIS $10.00.

For Aerojet-General Corp., Azusa, CA.

The methods by which Bendix plans to achieve reliability and quality assurance guides are detailed. (LTN)

35373 (TID/SNA-1153) PROJECT ALPHA NUCLEAR PROPULSION SYSTEM PRESSURE VESSEL. Preliminary Design. Volume II. Croy, E. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). 28 Feb 1961. 173p. Dep. NTIS $11.75.

The structural development program for a nuclear rocket engine pressure vessel is described. The objective of the program is to establish a reliable flight-weight design compatible with the requirements for integration of all engine and vehicle components. (JWR)

35374 (TID/SNA-1158) NTO SEMI-MONTHLY PROGRESS REPORT FOR THE PERIOD OF FEBRUARY 16–29, 1968. Wayne, W. D. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 12 Mar 1968. 24p. Dep. NTIS $4.25.

Some hundreds of work items in progress are reported. Most relate to test facility operation or modification, as to particular reactors: NRX-A6, XE-PRIME, PHOEBUS-2, XECF. (LTN)

35375 (TID/SNA-1163) NERVA VIBRATIONAL PROGRAM. Preliminary Report. Severson, R. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). 18 Jan 1963. 22p. Dep. NTIS $4.25.

The purpose of the Vibrational Program is to determine the fundamental and higher vibrational modes of the NERVA thrust structure–engine combination. Such effects as gimbal actuator stiffness and clearances, joint clearances and structural damping will be considered. The method of vibrational model determination will be to electrically simulate the engine structure by a correct arrangement of inductors, capacitors, resistors and transformers. Such an arrangement of electrical components is known as a passive analog computer. The analog set up for Part I of the program is described. (auth)

35376 (TID/SNA-1165) NUCLEAR ROCKET SIZING STUDY, SUMMARY BRIEFING. Johnson, H. L.; Waldo, R. D. (Aerojet-General Corp., Azusa, Calif. (USA)). 15 Jul 1963. 16p. Dep. NTIS $4.00.

35377 (TID/SNA-1180) REVISED WORK STATEMENT. (Aerojet-General Corp., Azusa, Calif. (USA)). 20 May 1964. 208p. Dep. NTIS $13.50.

A detailed statement of work planned for this contract year involves KIWI and NRX-A reactors in various stages of progress. Also considerable test facility work and design, development and testing of critical components are planned. The work is reviewed on a project basis. (LTN)

35378 (TID/SNA-1184) LRP CONTRIBUTIONS TO THE NERVA PROGRAM PLANNING AND COST STUDY FOR CONTRACT YEAR 1963. Odgers, I. L. (Aerojet-General Corp., Sacramento, Calif. (USA)). 24 Oct 1962. 135p. Dep. NTIS $9.75.

35379 (TID/SNA-1186) SNP-1SA3 CONTRACT MONTHLY LETTER REPORT FOR THE PERIOD 27 NOVEMBER 1963–26 DECEMBER 1963. Peterson, J. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 6 Jan 1964. 113p. Dep. NTIS $8.75.

Progress in the design, development, fabrication, and testing of various NERVA components and controls is reported. Substantial revisions are being made in the CY 1964 work plan as a result of program redirection by SNPO-C. (LTN)

35380 (TID/SNA-1187) SNP-1SA3 CONTRACT MONTHLY LETTER REPORT FOR THE PERIOD 27 OCTOBER 1963–26 NOVEMBER 1963. Peterson, J. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 14 Dec 1963. 121p. Dep. NTIS $9.25.

35381 (TID/SNA-1189) SNP-1: WORK STATEMENT. Period Covered, March 1, 1964–September 30, 1964. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Mar 1964. 136p. Dep. NTIS $10.00.

35382 (TID/SNA-1191) CURRENT STATUS OF SCALE-MODEL DUCT PROGRAM FOR NERVA EXHAUST DISPOSAL SYSTEM. Revision 1. McFarland, B. L.; Nelson, R. E.; Patmor, G. O. (Aerojet-General Corp., Sacramento, Calif. (USA)). 21 Jun 1962. 36p. Dep. NTIS $5.00.

Early design considerations of a Nuclear Exhaust System for Engine Test Stand No. 1 are reported, mainly the estimated requirements and the results and status of some scale model experiments. This system is needed to carry away the hydrogen from the test engine in a safe manner to a place where it can be burned safely and to provide altitude simulation in the tests. (LTN)

35383 (TID/SNA-1198) PHOEBUS-2 PRESSURE/VESSEL NOZZLE INTERFACE ANALYSIS. Appendix to Part IV. Stress Analysis. (Aerojet-General Corp., Sacramento, Calif. (USA)). 27 Jul 1965. 380p. Dep. NTIS $22.00.

This appendix contains all pertinent stress analysis data regarding the FLAT-C31 interface configuration not included in the basic report; specifically, all input and output of the PETS Computer Code and materials properties and temperature profiles of the pressure vessel and nozzle components. (auth)

35384 (TID/SNA-1199) N-4 PROGRESS REPORT FOR PERIOD 21 JULY–20 AUGUST 1965. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1965. 22p. Dep. NTIS $4.25.

Results of experiments and theoretical calculations on the PHOEBUS-1A reactor are reported. Computer calculations are reported as follows: hybrid computer studies; DDP-116 studies of time and storage required for certain proposed work; transfer functions; reactor models; hydrogen properties calculated from a polynomial function of enthalpy in which the coefficients are polynomial functions of pressure. Experiments with reactor control systems and reactor instrumentation are reported (control rod drives, thermocouples, pneumatic oscillators, pipeline characteristics, etc.). (LTN)

35385 (TID/SNA-1203) NRX-A5 DRAGON MEMORANDA FOR EXPERIMENTAL PLAN III. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 130p. Dep. NTIS $9.50.

The memoranda of the Data Reduction and Analysis Group on NERVA (DRAGON) for EP-III of the NRX-A5 test series performed on June 8, 1966 are documented. The purpose is to assist management in achieving the following objectives: To determine the degree to which the objectives have been met; to determine the condition of the test article and associated instrumentation with respect to capability of performing additional testing; and to determine the desirability of conducting the next test as planned in light of information obtained from previous tests. This effort was accomplished primarily by interpretation of recorded data and consultation with AGC, NTO, and WANL engineering organizations. (auth)

35386 (TID/SNA-1207) NERVA SPACE ENVIRONMENT ASSESSMENT (PHASE I). Hammel, R. L. (TRW, Inc., Cleveland, Ohio (USA)). 1 Sep 1967. 20p. Dep. NTIS $4.00.

In order to assess maximum equilibrium, continuous sunlight temperatures, subsequent eclipse cool down and heat up temperature profiles, a ten-node thermal model of the NERVA engine system has been analyzed. During sunlight exposures the analysis assumes the engine system is slowly rotating about its longitudinal axis at a rate greater than the thermal time constant of the system. Equilibrium temperatures were developed for the case of maximum projected area, that is, sun aspect normal to the longitudinal axis. Eclipse conditions are developed on the basis that complete engine shadowing occurs due to propellant tankage, as might occur with the vehicle longitudinal axis being sun oriented. The geometric relationships were based on AGC Drawing No. 1118422. The material identifications and weights were obtained from the TRW mission analysis group and Aerojet General Corporation. The analytical program provides results which are believed 99% reliable

to within 20°F for the model used. The results are intended as a first approximation only and must be interpreted accordingly; a more complete analysis would require additional calculations. For the space environmental assessment the most important result is to provide extremes which might be incurred as a result of vehicle orientation within general mission applications. (auth)

35387 (TID/SNA-1208) ADHESION TESTS, PROGRESS REPORT IV. Clausing, R. E. (Oak Ridge National Lab., Tenn. (USA)). 11 Sep 1967. 4p. Dep. NTIS $4.00.

Adhesion tests of a high strength, hardened 440-C alloy on itself were run after the usual cleaning (bakeout, degas, argon ion and electron bombardment). No significant degree of adhesion was observed with this material. (LTN)

35388 (TID/SNA-1211) TEST PLAN FOR THE NRX-A NON-NUCLEAR ASSEMBLY STRUCTURAL ACCEPTANCE TESTS. Thomas, R. W. (Aerojet-General Corp., Sacramento, Calif. (USA)). 17 May 1963. 23p. Dep. NTIS $4.25.

Acceptance test specifications and group responsibilities are defined for the NRX-A1, A2, and A3 non-nuclear assemblies (pressure vessels and nozzles). They involve pressure testing, deflection and strain data at and adjacent to the pressure vessel-nozzle attachment joint. (LTN)

35389 (TID/SNA-1212) HOT BLEED DEVELOPMENT TEST PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA)). 6 Apr 1964. 30p. Dep. NTIS $4.50.

Plans for testing a Hot Bleed NERVA Nozzle using LH_2/LO_2 combustion to simulate nuclear firing are presented. (LTN)

35390 (TID/SNA-1216) CAST ALUMINUM ALLOY JACKET MATERIALS DEVELOPMENT PROGRAM FOR THE NERVA NOZZLE. First Summary Status Report for Period May–September 1962. Inouye, F. T. (Aerojet-General Corp., Sacramento, Calif. (USA)). 26 Mar 1963. 153p. Dep. NTIS $10.75.

Au, Ni, Ag, Cu, and eutectic 82% Au–18% Ni alloy were evaluated for primer application utilizing the "Static Melt Consolidation Process." Several of these primers were found to metallurgically react with cast A-356 aluminum alloy when the "Static Melt Consolidation Process was employed. Au appears to be most promising. Bonding inconsistencies were found to occur in several cases, indicating that further refinements in primer application are required. Metallurgical bonds evident in "as-cast" samples were fractured by T-6 heat-treatment quenching, which suggests the advisability of using the T-51 heat treatment or a self-aging cast aluminum alloy. A tube bundle submitted by Arthur Tickle Engineering Works, Brooklyn, New York was evaluated revealing the absence of a metallurgical bond between the tube bundle and cast aluminum alloy jacket. (90 figures) (auth)

35391 (TID/SNA-1217) NERWI HYDROSTATIC TEST STRUCTURAL EVALUATION REPORT. Thomas, R. W. (Aerojet-General Corp., Sacramento, Calif. (USA)). 5 Sep 1963. 181p. Dep. NTIS $12.25.

Declassified 21 Apr 1965.

A hydrostatic test of an ACF Industries pressure vessel–Aerojet-General Corporation hybrid nozzle was performed to verify experimentally the compatibility of the pressure vessel-nozzle attachment joint. The test assembly reached maximum pressures of 680 psig in the pressure vessel zone and 565 psig in the nozzle zone at which time a premature failure of the nozzle shear lip occurred. A failure analysis has been conducted and reported; failure was due to low mechanical properties in the nozzle jacket. A total of 66 channels of instrumentation were being continuously recorded at the time of failure. Another 117 channels of instrumentation were being recorded at pressure increments, the highest being 637 psig in the pressure vessel zone. Compatibility of the assembly was demonstrated with the qualification that mechanical properties of the nozzle jacket be improved. Considerable data were obtained for correlating with the analysis and for design improvement. The method of analysis was basically verified. (auth)

35392 (TID/SNA-1221) LRP INPUT FOR THE COLD FLOW DEVELOPMENT TEST SYSTEM TEST PROGRAM PLAN. (Aerojet-General Corp., Sacramento, Calif. (USA)). 10 Sep 1963. 212p. Dep. NTIS $13.75.

The primary test objectives of the Cold Flow Development Test System (CFDTS) are: To verify the control functions and startup sequence of operations previously determined by transient analysis of a mathematical model; and to evaluate flow characteristics of an unfueled nuclear engine system to determine chilldown time, temperatures, flow rates and pressure drop data throughout the system. Secondary test objectives are: To test functionally an unfueled nuclear engine assembly and its components as an integrated system to evaluate potential thermal shock problems, operational characteristics and other phenomena associated with the starting transient; to develop a reliable startup procedure for the engine system; to evaluate the effect of tank pressure, turbine power control valve setting and diluent valve setting on engine startup performance; and to demonstrate the bootstrapping capability of the system. Detailed system plans and planned experiments are developed. (auth)

35393 (TID/SNA-1223) TEST SPECIFICATIONS AND PROCEDURES FOR NERVA THRUST STRUCTURE S/N 001TS RESONANCE SURVEY. Locke, J. N. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Apr 1963. 14p. Dep. NTIS $4.00.

A resonance survey of a NERVA thrust structure assembly, S/N 001TS, shall be conducted to determine its natural frequencies and mode shapes; the test specifications and procedures described are intended to supplement information previously provided. The structures are presently being fabricated at LRP and prior to this test shall be subjected to a static limit load survey. The testing will be conducted at room temperature and will provide information on the dynamic characteristics of the thrust structure for use in design. (auth)

35394 (TID/SNA-1224) TEST PLAN FOR THE NERWI HYDROSTATIC TEST. Brown, S. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 27 Aug 1962. 20p. Dep. NTIS $4.00.

Specifications for conducting the hydrostatic pressure test of the KIWI-B Pressure Vessel and Hybrid NERVA Nozzle Assembly, hereinafter called the NERWI Assembly, are established. Testing will consist of a hydrostatic pressure test using a nozzle simulator, followed by a test of the pressure vessel in combination with the actual nozzle. The nozzle assembly will be subjected to a test consisting of a stresscoat test, utilizing appropriate fore- and aft-end closure fixtures to contain a hydrostatic pressure within the nozzle chamber. Thus, based on the results of this stresscoat test, strain gage and deflection instrumentation will be located on the nozzle for use in the test of the pressure vessel-nozzle combination. (auth)

35395 (TID/SNA-1227) NERVA NRXA-ICF INSTRUMENTATION ENVIRONMENTAL PERFORMANCE TEST OF THREE (3) CLEVITE ACCELEROMETERS, PIEZOELECTRIC TYPE, MODEL 25D2IX, SERIAL NOS. 5189, 5192, AND 5193. (Component Evaluation Labs., El Monte, Calif. (USA). Electronic Div.). [nd]. 28p. Dep. NTIS $4.50.

For Aerojet-General Corp., Sacramento, CA.

The purpose of this test program was to perform environmental testing of the AGC instrumentation for NERVA NRXA-ICF Test program, on three Clevite Accelerometers, Piezoelectric Type. The Initial Performance and Medium Temperature tests were conducted without incident. During the Functional Test at low temperature, the coaxial cables which interconnect the accelerometer to the amplifier, shorted out; therefore, the test was aborted. A test was performed on the coaxial cables after they returned to laboratory ambient. Two of the three cables revealed a shorted condition at laboratory ambient, and the third cable revealed an intermittent short. Aerojet-General Corporation was notified of the above condition, and testing was discontinued until receipt of new cables from them. After receipt of the replacement cables, the Initial Performance Test was rerun, and the cables and accelerometers were then placed into Humidity testing. After Humidity testing, and per the request of Aerojet-General Corporation Engineering, the replacement cables were tested with a megohmmeter and found to be less than 90,000 ohms from center conductor to shell. Aerojet-General Corporation Engineering was notified of this fact and, per their request, testing was concluded. (auth)

35396 (TID/SNA-1237) NERVA SUPPORT EQUIPMENT OPERATION AND MAINTENANCE INSTRUCTIONS. (Aerojet-General Corp., Sacramento, Calif. (USA)). 30 Apr 1964. 15p. Dep. NTIS $4.00.

A tool kit (GSE Item 9, TOOL KIT, ROCKET ENGINE-REMOTE (PN 293752-9)) consists of two impact socket wrenches, two fixed universal adapters, and one impact wrench housing. It is used for remote (with O-MAN impact wrench) or manual (with a standard torque wrench) installation or removal of bolts. Lubricate with Never-Seez, DC-11, or equivalent as required. (LTN)

35397 (TID/SNA-1243) TEST SPECIFICATIONS FOR THE STATIC STRUCTURAL TEST OF THE NERVA TITANIUM PRESSURE VESSEL, S/N 001T. Hales, F. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 17 Jun 1963. 42p. Dep. NTIS $5.25.

Specifications and procedures are established for the structural testing of the NERVA Titanium Pressure Vessel, in accordance with requirements outlined in the Structural Development Program Plan, No. 9548-62-2, Revision A, dated 20 November 1962. (auth)

35398 (TID/SNA-1250) STRUCTURAL DEVELOPMENT TEST PLAN, NERVA ALUMINUM PRESSURE VESSEL S/N

0000003. (Aerojet-General Corp., Sacramento, Calif. (USA)). 26 Sep 1963. 14p. Dep. NTIS $4.00.

The structural testing and associated structural analysis planned for NERVA aluminum development pressure vessel S/N 0000003 are described. The main purpose is to determine pressure vessel forward closure bolted joint and nozzle bolted joint behavior when subjected to a one zone pressurization. In addition, the displacement of control drum ports will be measured to supplement data acquired in the previously completed hydrostatic test of pressure vessel S/N 0000002, Test 808N. Also necessary data for a correlation of analytical and experimental results will be obtained. (auth)

35399 (TID/SNA-1251) STRUCTURAL DEVELOPMENT PROGRAM NERVA THRUST STRUCTURE. (Revision B). (Aerojet-General Corp., Sacramento, Calif. (USA)). 17 Apr 1962. 19p. Dep. NTIS $4.00.

The structural testing and associated structural analysis of the initial NERVA upper and lower thrust structures are described. The information obtained will be used, along with data from other development programs, to develop a reliable thrust structure for the NERVA E-engine. (auth)

35400 (TID/SNA-1252) TEST PLAN FOR VENDOR ALUMINUM PRESSURE VESSEL ACCEPTANCE PROOF TESTS. Thomas, R. W. (Aerojet-General Corp., Sacramento, Calif. (USA)). 25 Jul 1963. 14p. Dep. NTIS $4.00.

The objective of this test is to demonstrate that each pressure vessel is capable of withstanding ambient temperature proof pressure in accordance with the following acceptance criteria: (a) the pressure vessel components, forward closure and cylinder, shall not rupture, (b) after testing, the cylinder shall not have permanent deformation in excess of 0.2% of the circumferential dimensions taken before the test and (c) all significant interface dimensions shall be within drawing specification. (auth)

35401 (TID/SNA-1255) HEAT TRANSFER ANALYSES ON KIWI-B THRUST CHAMBER. Part I. Hester, J. N. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 Nov 1962. 38p. Dep. NTIS $5.00.

An analysis of the heat transfer characteristics of the KIWI-B thrust chamber was undertaken to determine the behavior of the nozzle jacket and the nozzle-to-pressure vessel flange during operation in a nuclear environment; the behavior of the nozzle jacket and the nozzle to injector adapter during a LO_2/LH_2 simulation run; and the behavior of the nozzle throat during a LO_2/LH_2 start transient simulation run. Temperature distributions are presented for both the nuclear and simulation conditions. The thrust chamber will not experience heat transfer difficulties during the simulation run. However, during the operation of the nuclear reactor, the region between bolts in the nozzle-to-pressure vessel flange will require both further analysis and some redesign. This is largely due to the unequal distribution of heat in this area in relation to the location of the coolant. (auth)

35402 (TID/SNA-1256) NNRDC ENGINE TEST STAND EXHAUST SYSTEM HOT-FLOW SCALE TEST PROGRAM AND STRUCTURAL DESIGN STUDIES AND TEST. (Aerojet-General Corp., Azusa, Calif. (USA)). Jan 1962. 86p. Dep. NTIS $7.50.

In general, the requirements imposed on the ETS-1 (or ETS-2) deflector duct specify that it provide: altitude simulation, explosion-free operation, safe ducting of explosive gases away from engine, structural integrity during operation, and utilization of a reasonably sized envelope for vertical-engine testing. Taken together, these interrelated requirements necessitate the verification of design utilizing scale-model tests. Test results to date with the ETS-1 model indicate severe heat-transfer and flow-dynamics problems which require solution. This proposal includes discussion of a testing program designed to obtain additional data for successful design of the ETS-2 exhaust system. Test programs are outlined for a convectively cooled duct and for a configuration providing the addition of water into the duct at areas of high heat flux. Some of the data for planned test programs will be obtained for the present duct with necessary modification of the elbow to accommodate the high heat fluxes. However, since it is not certain that such an objective can be realized, parallel test efforts are proposed. These will include the following changes in duct configuration: slanting of the duct, changing the elbow radius, changing the overall duct height, and changing the duct diameter. The necessity for this early and vigorous scale test program is obvious. If tests are conducted early enough in the program, design decisions need not be made on the basis of analysis alone, thus avoiding the risk that ultimate tests do not verify the conclusions. Delay could jeopardize the development time of the NERVA nuclear rocket engine. A schedule is submitted in this proposal which reflects the objective of obtaining critical data in the shortest possible time. (auth)

35403 (TID/SNA-1258) FINAL ACCEPTANCE TEST PLAN FOR NRX-A1 END ITEMS. Revision 2. Barr, K. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). 25 Nov 1963. 48p. Dep. NTIS $5.50.

The criteria and procedures are outlined for Final Acceptance Tests of the NRX-A1 non-nuclear end items prior to their delivery to NRDS for reactor development testing. These criteria and procedures are based upon the technical performance requirements of the NRX-A1 component designs and the program requirements defined in the NRX-A1 Test Plan TNR-097 and the NRX-A1 Test Specification TNR-121. The acceptance testing of the NRX-A1 non-nuclear engine system consists of inspections, environmental component tests and component proof tests, the results of which are confirmed by a Final Non-Nuclear Engine Assembly Acceptance Test establishing the quality and reliability of the engine system. (auth)

35404 (TID/SNA-1260) NERVA MARK III TURBOPUMP PERFORMANCE SUMMARY HANDOUT. Andrews, F. X.; Bair, E. K.; Cunningham, R. D.; Goundrey, R. L.; Johnson, D. E.; Klug, J. J.; Peirson, G. H.; Shigemoto, T. Y. (Aerojet-General Corp., Sacramento, Calif. (USA)). 25 Feb 1964. 60p. Dep. NTIS $6.00.

35405 (TID/SNA-1261) STRUCTURAL DEVELOPMENT PROGRAM NERVA THRUST STRUCTURE. (Aerojet-General Corp., Sacramento, Calif. (USA)). 17 Apr 1962. 19p. Dep. NTIS $4.00.

The planned structural testing and associated structural analysis of the initial NERVA upper and lower thrust structures are described. The information obtained will be used, along with data from other development programs, to develop a reliable thrust structure for the NERVA E-engine. The flight environment includes nuclear radiation and temperature distributions along the thrust structure. Axial and lateral accelerations result in axial, lateral and bending loads on both structures. The temperature and irradiation effects will be considered only in the theoretical analysis to support fabrication drawing approvals. Testing will be performed at ambient temperatures in a non-nuclear environment using static loads. Following this test program the two units will be used in the resonance survey test program. (auth)

35406 (TID/SNA-1265) DEVELOPMENT OF NUCLEAR ROCKET PROPULSION IN THE UNITED STATES. House, W. C. (Aerojet-General Corp., Azusa, Calif. (USA)). 9 Oct 1963. 56p. Dep. NTIS $6.00.

It is the purpose of this paper to present the overall history and status of nuclear rocket developments in the United States, to indicate the goals and objectives of the present development activities, and to illustrate some possible mission applications for engines of the class under development. Historical milestones are presented and discussed, starting with the first published mention of the nuclear rocket concept in 1944, with particular emphasis devoted to events since 1957, the year the Kiwi reactor development program was initiated–the reactor destined for ultimate use in the nuclear rocket engine system. The Kiwi program is described, the test dates and objectives indicated, and the test results presented to provide an understanding of the background and development status of the reactor for the nuclear rocket application. The Kiwi reactor test procedures and facilities are described and the test site selection is reviewed. The NERVA engine development program is discussed, starting with the initiation of the effort in mid-1961 and continuing through the present date. Guidelines and objectives established at the initiation of the program are outlined. The engine and its subsystems and components are described. The unique test facility requirements are presented, together with a description of the facilities now under construction. The special remote handling, transport, and assembly/disassembly equipment required for the engine development test program are described and discussed. The Government organization established for the management of the entire nuclear rocket propulsion and vehicle stage programs is outlined. Finally, the application of the in-development class engine to some initial missions of interest is explored, assuming that the nuclear-propelled stage is the third stage of the SATURN V launch vehicle. Some comparisons are made with the all-chemical counterpart vehicle. Lunar landing and planetary fly-by missions are considered, and solar system capability is indicated. (auth)

35407 (TID/SNA-1292) APPLICATION OF NUCLEAR PROPULSION TO A LUNAR LOGISTICS SYSTEM FOR THE POST-APOLLO PERIOD. Period Covered, 28 February 1964–21 August 1964. (Space-General Corp., El Monte, Calif. (USA)). Aug 1964. 69p. Dep. NTIS $6.50.

The post-Apollo period (presently undefined as to mission objectives) will be a continuation of initial lunar exploration

activity and probably will include construction of a lunar base because only limited exploration and research can be conducted without a base. Scientific research would be desirable in areas particularly associated with the moon and in other areas of research that can be conducted advantageously from a lunar base. Investigation of the lunar surface and subsurface would require extensive instrumentation for mapping, sampling, and surveying with magnetic, gravimetric and seismic techniques. Special research might be done on mare formation, crater shape and surface thermal anomalies. An astrophysical observatory on the moon would provide data related to space astronomy and solar observations. Knowledge of physics of the sun could be greatly increased from observations made outside the earth's atmosphere with respect to radiation distribution, spectral phenomena and magnetized plasma and corresponding changes with time. The design and characteristics of spacecraft for such missions is discussed. (auth)

35408 (TID/SNA-1295) UPPER THRUST STRUCTURE, S/N 882013 ACCEPTANCE TEST REPORT. Swanson, E. T. (Aeronca, Inc., Torrance, Calif. (USA). Aerocal Div.). 6 Nov 1967. 52p. Dep. NTIS $5.75.

For Aerojet-General.

The results of static load tests on the NERVA upper thrust structure are presented. The objectives of the tests were to demonstrate the structural integrity to XE-1 engine loads and to provide deflection data needed to compute the axial and lateral spring constants of the assembly. (JWR)

35409 (TID/SNA-1296) ENGINEERING METHODS: PRACTICAL APPROACH TO SELECTING DESIGN SAFETY FACTORS BASED ON THE DISTRIBUTION OF STRESS AND STRENGTH. Volume I. (Aerojet-General Corp., Sacramento, Calif. (USA)). 18 Sep 1968. 65p. Dep. NTIS $6.25.

This first volume is concerned primarily with the practical aspects of determining design safety factors, and the second is devoted mainly to the theoretical justification of the formulas and techniques and to a discussion of the associated problems and limitations. The formula which relates safety factor to structural reliability and to the statistical distributions of stress and strength is given in two forms — mathematical and graphical. The proper method of using this formula in structural analyses is illustrated by a simple example and is briefly described in procedural form. Volume I is concluded by a summary of the limitations involved in implementing the methodology in practical applications. (auth)

35410 (TID/SNA-1297) PRACTICAL APPROACH TO SELECTING DESIGN SAFETY FACTORS BASED ON THE DISTRIBUTION OF STRESS AND STRENGTH. Volume II. (Aerojet-General Corp., Sacramento, Calif. (USA)). 18 Sep 1968. 57p. Dep. NTIS $6.00.

35411 (TID/SNA-1304) SAFETY CONSIDERATIONS RELATIVE TO CONSTRUCTION OF E/STS 2-3. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1967. 243p. Dep. NTIS $15.25.

A detailed review of the hazards and the safety precautions at the proposed Engine Test Stands 2 and 3 for testing higher power engines for longer times is presented. The hazards involve hydrogen explosions, nuclear accidents, nuclear radiations, fission product releases, cryogenic and high pressure gases, etc. These hazards, in terms of the amounts involved, are roughly about ten times those experienced at ETS-1. The facility structures, monitoring methods, spacing structures and inventories, etc. are reviewed with a complete description of the various safety features. The problem of radioactive effluents and their possible spread off the test site area and effects on people, milk, etc. are treated in detail. The use of a scrubber, and testing only under favorable meteorological conditions, is regarded as a necessity for normal operations. But it is recognized that this might not be satisfactory if a serious nuclear accident occurred and, in such a case, milk, for example, might have to be destroyed over a large area. A few remaining problems are noted. (LTN)

35412 (TID/SNA-1308) IRRADIATION TEST, PRELIMINARY REPORT. Guinn, J. W.; Pou, C. G. (General Dynamics/Fort Worth, Tex. (USA)). 2 Nov 1964. 84p. Dep. NTIS $7.25.

Candidate turbopump bearings were exposed under cryogenic conditions in the ASTR reactor. After irradiation and some decay time the bearing was sent to Aerojet General Corp. for disassembly and examination. (LTN)

35413 (TID/SNA-1309) NERVA PROGRAM REQUIREMENTS DOCUMENT. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1969. 65p. Dep. NTIS $6.25.

Program requirements for the performance, design, development, test and scheduling of the NERVA Propulsion and Test Systems are established. This is the 6th revision of this document for the 75K, Full Flow NERVA engine. (LTN)

35414 (TID/SNA-1310) BUDGETARY STUDY FOR ENGINE/STAGE TEST STAND (E/STS) 2-3, NUCLEAR ROCKET DEVELOPMENT STATION, JACKASS FLATS, NEVADA. Evaluation of Wet Versus Dry Systems and Supporting Studies for NERVA Exhaust and Altitude Simulation System. Supplementary Project Report. (Kaiser Engineers, Oakland, Calif. (USA)). 17 Jan 1967. 316p. Dep. NTIS $17.00.

The performance of the exhaust duct used for cooling and diluting the test engine exhaust hydrogen and transporting it to a place where it could be burned safely was reviewed in view of the possible construction of Engine Test Stands No. 2 and 3. This duct contained a scrubber to deposit some of the radioactive effluents and was operated with a huge steam injector to provide altitude simulation for the engine test. The unit was subjected to very high thermal and mechanical stresses during the engine tests. As a result of the review various alternative designs and methods of operation (wet or dry) were considered by the several companies involved for the construction at ETS No. 2 and 3. (LTN)

35415 (TID/SNA-1311) LECTURE NOTES ON SYSTEMS MAINTAINABILITY. (Bazovsky (Igor) and Associates, Inc., Sherman Oaks, Calif. (USA)). Mar 1970. 65p. Dep. NTIS $6.25.

For Aerojet-General, Sacramento, CA.

Some ideas on systems maintainability, for use in the NERVA program, are presented. Topics covered include maintainability concepts, measures of maintainability, maintenance time distributions, and maintainability prediction methods. (JWR)

35416 (TID/SNA-1312) STRUCTURAL DEVELOPMENT PROGRAM. NERVA Thrust Structure. 11 January 1962–30 April 1963. Revision A. Thomas, R. W. (Aerojet-General Corp., Sacramento, Calif. (USA)). 31 Dec 1962. 13p. Dep. NTIS $4.00.

The structural testing and associated structural analysis of the initial NERVA upper and lower thrust structures are described. The information obtained will be used, along with data from other development programs, to develop a reliable thrust structure for the NERVA E-engine. (auth)

35417 (TID/SNA-1317) ENVIRONMENTAL EVALUATION TESTING OF NERVA NRXA-2HF INSTRUMENTATION. Supplement 1. (Aerojet-General Corp., Sacramento, Calif. (USA)). Mar 1964. 27p. Dep. NTIS $4.50.

Candidate pressure transducers were evaluated for operation between −300° and 740°F. The high temperature tests were terminated due to a cable failure at 765°F. Some difficulty was encountered in the low temperature tests due to oil and dirt freezing in the units. Some of the units were difficult to clean properly on account of internal crevices and passageways. Also they developed a set when exposed to steady negative pressures overnight. (LTN)

35418 (TID/SNA-1322) HANDBOOK HEALTH AND SAFETY DATA AND PROCEDURES. Volume I. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 31 Dec 1963. 229p. Dep. NTIS $14.50.

35419 (TID/SNA-1323) HEALTH AND SAFETY INSTRUCTIONS. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 15 Sep 1963. 134p. Dep. NTIS $9.75.

The Safety Manual includes sections on beryllium, liquid hydrogen, pressure systems and radiation, as well as sections on conventional safety practices in shop and office areas. (LTN)

35420 (TID/SNA-1337) NERVA TECHNICAL ADMINISTRATION DOCUMENTS. Work Statements. Addendums 7, 8, 10, 11, and 15. (Aerojet-General Corp., Sacramento, Calif. (USA)). 16 Dec 1963. 18p. Dep. NTIS $4.00.

35421 (TID/SNA-1340) MECHANICAL IRRADIATION TEST 3/L003 TURBOPUMP BEARING SET. Final Test Report. Young, F. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). 23 Apr 1964. 59p. Dep. NTIS $6.00.

Nonlubricated, hydrogen-cooled roller- and ball-bearing assemblies were operated at cryogenic temperatures in a nuclear radiation field. The bearings are candidate NERVA turbopump bearing sets. Two sets of AGC PN 290156-109 roller bearings and one pair of AGC PN 287812-19 ball bearings were tested. The roller bearing rollers, inner races, and outer races were made of Mod 440C steel; the cage material was polytetrafluoroethene laminated fabric. The ball bearing assemblies used Mod 440C (HTST) balls, inner races and outer races, and fluorinated ethylene propylene laminated fabric cages. The bearings were operated within a

temperature range of −423 to −300°F at 24,000 rpm under 2000 lb radial and axial loads. The measured integrated neutron fluxes to which the bearing tester was exposed ranged from 1.9×10^{12} to 9.3×10^{13} n/cm² (E > 2.9 MeV). Measured gamma doses ranged from 5.8×10^{6} to 1.1×10^{8} ergs/gm(c). A posttest visual examination of the bearings showed no evidence of degradation. (auth)

35422 (TID/SNA-1341) MECHANICAL IRRADIATION TEST 3/L001 TURBOPUMP BEARING SET. Volume I. Final Test Report. Durkee, W. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1964. 80p. Dep. NTIS $7.00.

Candidate turbopump bearings mounted on NERVA Bearing Tester P/N 263520-39, S/N 0000002 were tested at the General Dynamics, Fort Worth, Texas reactor facility on 17 July 1963. This test (mechanical irradiation Test #901) was conducted at the Aerospace Test Reactor (ASTR). Reactor power level was maintained at 10 megawatts for the entire test duration of 327 seconds. Bearing operation with low thrust loads at 23,000 rpm was terminated after 155 seconds, when a pre-established bearing temperature kill limit of −150°F was reached. The bearing temperature increase, experienced during the test, is attributed to a combination of nuclear heating and an inadequate mass flow of hydrogen, not to bearing malfunction. The inadequate mass flow of hydrogen was a result of the large system pressure drop and the facility limited hydrogen supply pressure. Operation of the bearings was normal and the test was considered satisfactory. The tester was disassembled. All components showed only the normal signs of operation and were in good condition. Both roller bearings and thrust bearings were in good condition. The roller cages showed evidence of very slight pocket burning and a slight discoloration on the pump-end bearing inner race. (auth)

35423 (TID/SNA-1342) MECHANICAL IRRADIATION TEST NO. 8/L001 STATIC FLANGE SEAL ASSEMBLY. Volume IV. Final Test Report. Warner, M. H. (Aerojet-General Corp., Sacramento, Calif. (USA)). 16 Mar 1964. 40p. Dep. NTIS $5.00.

Three combinations of stainless steel and aluminum flanges with aluminum or stainless steel gaskets were exposed to between 3.7×10^{13} and 9.0×10^{12} n/cm² of fast neutrons (E > 2.9 MeV) and a gamma radiation of from 1.3×10^{7} to 8.1×10^{7} ergs/gm(c). Temperature and pressure of the H_2 was monitored during the test, and leak checks and visual inspections were conducted during pre- and post-irradiation tests. No apparent damage to seals or flanges resulted from the irradiation test. There was an apparent change of bolt torque values on joints between pre- and post-irradiation tests accompanied by an increase in leak rate for the joints affected. This is not attributed to radiation effects. (auth)

35424 (TID/SNA-1343) MECHANICAL IRRADIATION TEST NO. 1/L001 TANK SHUT-OFF VALVE, CONFIGURATION No. 1. Volume II. Final Test Report. Warner, M. H. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1964. 45p. Dep. NTIS $5.25.

A test was designed to provide preliminary information as to the suitability of a first configuration NERVA Tank Shut-off Valve (TSOV, P/N 259300, S/N 0000004) and its associated pilot valve and position indicator for operation in a combined cryogenic and radiation environment. The test was conducted on the Aerospace Test Reactor at General Dynamic's Nuclear Aerospace Research Facility in Fort Worth, Texas. The TSOV was immersed in low pressure liquid hydrogen and operated five times during the 327 second test while receiving an integrated dose of between 8×10^{12} to 9×10^{12} fast neutrons per cm² and a gamma dose of between 2.9×10^{7} and 4.0×10^{7} ergs per gram (carbon). From a comparison for pre- and post-irradiation test inspections, there was no apparent permanent deformation of the valve body or seat due to radiation effects and the valve seal was not functionally affected by the radiation received. (auth)

35425 (TID/SNA-1345) MECHANICAL IRRADIATION TEST No. 4/L001 TURBINE POWER CONTROL VALVE CONFIGURATION NO. 1. Volume III. Final Test Report. Warner, M. H. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1964. 44p. Dep. NTIS $5.25.

The NERVA Turbine Power Control Valve (TPCV) was tested to provide preliminary information as to suitability for operation in a radiation environment. The TPCV tested was designed for use in the hot bleed cycle engine. The irradiation test, which lasted for 327 seconds, was conducted on 17 July 1963, on the Aerospace Systems Test Reactor (ASTR) at General Dynamics Corporation, Fort Worth, Texas. The valve body and disc were exposed to ambient GH_2 at a low flow rate and a low pressure (115 psig). The valve was cycled once each 60 seconds and received a total integrated fast neutron dose of from 1.1×10^{13} n/cm² (E > 2.9 MeV) and a gamma dose of from 3.8×10^{7} to 8.1×10^{7} ergs/g(c). The valve operating times were satisfactory and there was no apparent damage tc valve, seat, or seals. (auth)

35426 (TID/SNA-1347) HYDROSTATIC PROOF TEST OF THE NRX-A ALUMINUM PRESSURE VESSEL, S/N 0000002. Smith, L. M. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Aug 1963. 207p. Dep. NTIS $13.50.

Declassified 21 Apr 1965.

In accordance with Test Plan Report No. 808N, NRX-A Pressure Vessel S/N 0000002 was instrumented with strain gages and deflection transducers, and subjected to proof pressure at laboratory ambient temperature on June 14, 1963. The vessel successfully sustained the pressure, proving the structural integrity of the design. The nozzle simulator, S/N 001S, utilized in this test also successfully withstood the programmed pressure. Predicted strains and deflections for the nozzle and pressure vessel were verified by the test data. (auth)

35427 (TID/SNA-1368) PRELIMINARY COMPUTING MANUAL: SC-4020 SUBPROGRAMS. (Aerojet-General Corp., Azusa, Calif. (USA)). Nov 1963. 67p. Dep. NTIS $6.50.

The S-C 4020 (designed and manufactured by General Dynamics Electronics) is a peripheral system which reads magnetic tape output from a computer program and produces graphical, pictorial, or alphanumeric output. As the tape is read, the desired lines and characters are displayed on a specialized cathode ray tube. Sensitized paper and/or film is exposed to the display and the results are developed and returned to the programmer. The obvious application of such a device is the rapid production of labeled graphs. Results in graphical form are usually much easier to analyze than are the same results in printed tabular form. Less obvious, but often highly desirable, is the exploitation of the S-C 4020 as a high-speed printer to record tabular data on 35 mm film. Large quantities of data can be stored in a small space, reducing the need for massive storage facilities. One variation with growing use is the production of tabular data and the related curve on one film frame, for formal reports. Still another use of S-C 4020 techniques is the creation of diagrams and line drawings. A complex of S-C 4020 output routines is available to write the S-C 4020 control instructions on an output tape. These are either in FORTRAN function or subroutine format. (auth)

35428 (TID/SNA-1373) IRRADIATION TEST, GTR-12. Preliminary Report. (General Dynamics/Fort Worth, Tex. (USA)). 17 Apr 1964. 54p. Dep. NTIS $5.75.

Selected components proposed for application in the NERVA engine (actuator components, accelerometers, pressure transducers, graphite) were irradiated in the GTR reactor. The dose varied within the range $(1-8)\ 10^{16}$ n/cm² and $(1-9)\ 10^{11}$ μgs/gm of gamma radiation. The results are described. (LTN)

35429 (TID/SNA-1386) 75K NERVA ENGINE MEETING. (Aerojet-General Corp., Sacramento, Calif. (USA)). 13 Aug 1968. 151p. Dep. NTIS $10.75.

Slides presented at a NERVA review meeting have been documented. Various specification trees are presented showing organizational relationships, mission relationships, launch relationships, and schedules. NERVA characteristics are given and launch and mission operations specified (for several possible missions). Finally, some detailed design information is given for the 75K engine. (LTN)

35430 (TID/SNA-1388) SNP-1SA3 CONTRACT MONTHLY LETTER REPORT FOR THE PERIOD 27 MARCH 1963−26 APRIL 1963. Peterson, J. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 4 May 1963. 142p. Dep. NTIS $10.25.

Monthly progress is reported, mostly on fabrication and/or procurement of items for the NRX-A1 and KIWI-B reactors. A nozzle failure in simulation testing is reported. Various design, development, and testing efforts and computer program modifications are mentioned. (LTN)

35431 (TID/SNA-1394) NERVA TECHNICAL DISCUSSIONS BY SUBTASK, CY 1964. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1964. 119p. Dep. NTIS $9.00.

35432 (TID/SNA-1398) ASTR-1 IRRADIATION TEST, PRELIMINARY REPORT. Crabtree, R. D.; Johnson F. H. (General Dynamics/Fort Worth, Tex. (USA)). 17 Jul 1963. 202p. Dep. NTIS $13.25.

The irradiation testing of NERVA mechanical components in a liquid hydrogen environment is described. (JWR)

35433 (TID/SNA-1399) ASTR-2 IRRADIATION TEST, PRELIMINARY REPORT. Laney, W. M.; Stanley, J. D. (General Dynamics/Fort Worth, Tex. (USA)). 16 Oct 1963. 138p. Dep. NTIS $10.00.

The irradiation testing of NERVA turbopump assembly bearings in a liquid hydrogen environment is described. (JWR)

35434 (TID/SNA-1452) INSTRUMENTATION FOR CRYOGENIC TEMPERATURE MEASUREMENTS OF THE NERVA

TURBOPUMP ASSEMBLY BEARINGS DURING NON-NUCLEAR STATIC TESTING. Farnham, J. W.; Chandon, H. C. (Aerojet-General Corp., Sacramento, Calif. (USA)). 19 Nov 1963. 69p. Dep. NTIS $6.50.

Three types of thermocouples have been developed to measure the temperature of the bearings in the NERVA turbopump assembly. When used with a resistance temperature transducer, gold-cobalt vs copper thermocouples are recommended for post experimental computation of the temperatures because they yield the most accurate data. Chromel vs alumel thermocouples, although less sensitive, are recommended to measure the bearing temperatures during the NERVA turbopump test runs and to indicate kill parameters. Copper vs constantan thermocouples are the least sensitive and will require more development before they are practical. They can be used but are not recommended at this time. The output conversion data of the three types of thermocouples is reported in both tabular and graphical form. The theoretical accuracy and dynamic precision for all three types of thermocouple systems are discussed. (auth)

35435 (TID/SNA-1460) RELIABILITY AND QUALITY ASSURANCE NERVA PROGRAM. Volume I. Reliability Program Plan. (Aerojet-General Corp., Sacramento, Calif. (USA)). Feb 1963. 91p. Dep. NTIS $7.75.

The purpose of the Reliability Program Plan is to establish the basic provisions for conducting a reliability program to insure high inherent reliability in the basic design. Specific objectives to be accomplished during this period are: To provide an organization and establish procedures to manage and conduct an objective reliability program; to document the design criteria, procedures, and information; to perform design reviews to assure that provisions have been made for adequate reliability considerations; to provide and update reliability apportionment; to utilize the most efficient techniques for test planning and to assure that the test plans are adequate for hardware development and evaluation; to acquire, compile, evaluate, distribute, and store data regarding the operation of the engine and function of the engine components; to analyze test data to define problem areas and to determine level of achieved reliability; and to provide management and engineering with reliability reports and data required for conducting and improving the program. (auth)

35436 (TID/SNA-1462) NERVA QUALITY CONTROL AND RELIABILITY STATUS REPORT FOR THE PERIOD 21 DECEMBER 1963–20 MARCH 1964. (Aerojet-General Corp., Sacramento, Calif. (USA)). 5 Apr 1964. 33p. Dep. NTIS $4.75.

Problems in the fabrication and simulation testing of nozzles are reported. A Failure Mode Analysis of nozzles has been completed. Reliability predictions have been made for various NRX-A1 components. Failure analyses have been made for several components and corrective action taken. (LTN)

35437 (TID/SNA-1477) SNP-1SA3 CONTRACT MONTHLY LETTER REPORT FOR THE PERIOD 27 SEPTEMBER 1963–26 OCTOBER 1963. Peterson, J. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 4 Nov 1963. 271p. Dep. NTIS $16.75.

Progress in the design and fabrication of reactor components is reported (for NRX-A1 and NRX-A2). Test facility progress is described. Radiation effects tests are described briefly. (LTN)

35438 (TID/SNA-1507) NERVA TECHNICAL DISCUSSIONS BY SUBTASK, CY 1964, ENCLOSURE (3). (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 119p. Dep. NTIS $9.00.

A review of progress in the various subtasks of the NERVA program is presented. (JWR)

35439 (TID/SNA-1508) MECHANICAL IRRADIATION TEST 3/L002, TURBOPUMP BEARING SET. Young, F. E. (Aerojet-General Corp., Sacramento, Calif. (USA)). 20 Mar 1964. 57p. Dep. NTIS $6.00.

Nonlubricated, hydrogen-cooled ball and roller bearing assemblies were operated at cryogenic temperatures in a nuclear radiation field. The bearings are candidate NERVA turbopump bearing sets. The bearings were in operation for five minutes at 24,000 rpm under radial and axial loads of 2000 lb. The bearing tester was exposed to integrated neutron fluxes ranging from 1.3×10^{12} to 5.2×10^{13} n/cm^2 (E > 2.9 MeV) and gamma doses ranging from 5×10^6 to 1.6×10^8 ergs/gm (C). The hydrogen coolant temperature increase of 120°F during the test attributed to gamma heating. A posttest visual examination showed no evidence of bearing degradation. (auth)

35440 (TID/SNA-1516) SNPO REVIEW OF THE REON SAFETY PROGRAM FOR CONTRACT YEAR 1964. (Aerojet-General Corp., Sacramento, Calif. (USA)). 19 Jan 1965. 16p. Dep. NTIS $4.00.

The test facilities in support of NERVA of the AGC Sacramento plant are described and illustrated by several pictures. They involve facilities for cryogenics, nozzle testing, cold flow system testing, turbopump development and testing, bearing testing, etc. The descriptions and pictures are good: safety is mentioned only incidentally. (LTN)

35441 (TID/SNA-1526) NRX/EST DRAGON MEMORANDA, EP-IA 4. EST 051–EST 072. (NERVA Test Operations, Jackass Flats, Nev. (USA)). [nd]. 172p. Dep. NTIS $11.75.

Experimental plan IA4 of the NRX/EST series was performed at NRDS on 19 January 1966. Five of the six planned cold flow runs were successfully completed. The objectives were to investigate performance characteristics of the engine system during start-up at low power; and to determine acceptable Dewar pressure and pressure demand settings for successful bootstrap start-ups in future experimental plans. In addition to the cold flow runs, cross correlation measurements of the power control loop were planned and made for 165 seconds at a power level of one kilowatt. The results of these runs are analyzed. (auth)

35442 (TID/SNA-1527) DRAGON MEMORANDA, EST 128–159, NRX/EST EP-III. (NERVA Test Operations, Jackass Flats, Nev. (USA)). [nd]. 257p. Dep. NTIS $16.00.

Experimental plan III of the NRX/EST series was performed at NRDS on March 3, 1966. The initial bootstrap startup attempt at low Dewar pressure [35 psia] was aborted by manual flow shutdown when the operating limit of the tie rod exit gas temperature was approached. A second bootstrap startup attempt, at 70 psia Dewar pressure, was successful and full power operation, close to the design point, was achieved for approximately 74 seconds. A maximum chamber temperature of approximately 4116°R was achieved for 9 seconds. The run was terminated by a normal programmed shutdown when an indication of excessive turbopump vibrational displacement was noted at high turbopump rotational speeds. An evaluation of the turbopump performance revealed normal and satisfactory behavior and an examination of the data signal from which TPA displacement was derived indicated that the data channel was unreliable. A subsequent bootstrap startup and mapping run was performed very successfully. The maximum chamber temperature was 3700°R; the maximum turbopump shaft speed was approximately 22,400 rpm and the maximum flow rate was about 90 pounds per second during the mapping run. The turbine power control valve actuator appeared to perform satisfactorily during the entire experimental plan. The planned objectives of EP III were as follows: Demonstration of bootstrap capability with a Dewar pressure of 35 psia; demonstration of the capability of the NRX/EST system to operate at its design point and to be maneuvered within the upper portions of its operating envelope; experimental determination of steady state limits of the upper portion of the operating envelope; demonstration of an "on-off" temperature controller performance; determination of NRX/EST system dynamic characteristics; and obtaining data for improvement of analytical models. (auth)

35443 (TID/SNA-1529) NUCLEAR ROCKET SYSTEMS FOR RAPID MANEUVERS OF MILITARY SPACE SYSTEMS. Report No. AG-10. Grey, J. (Aerojet-General Corp., Azusa, Calif. (USA)). 30 Apr 1962. 38p. Dep. NTIS $5.00.

This is a brief presentation of the arguments for the use of nuclear rockets in high-acceleration maneuvers in space. Several representative missions of this type are selected as examples, and it is concluded on the basis of some simple calculations that nuclear propulsion systems are well suited to this class of mission. Gross weights of the nuclear-powered maneuvering vehicles become smaller than those of chemical-powered systems as the required amount of maneuvering increases, and for high degrees of maneuverability are unquestionably superior on any basis of comparison. Of the various nuclear systems considered, the small, fast reactor concepts appear most generally suitable. The higher-performance systems such as low-pressure nuclear rockets or heat-addition nozzles, although providing excellent payload capability, suffer seriously from a number of other factors. (auth)

35444 (TID/SNA-1550) EVALUATION OF EXHAUST-SYSTEM CONCEPTS FOR NERVA-II STAGE GROUND TESTS. Grey, J. 1 Jun 1965. 70p. Dep. NTIS $6.50.

Analytical studies of a conventional exhaust system for NERVA-II engine or stage testing were conducted, assuming a 40 : 1 engine nozzle expansion ratio, an ideal normal-shock primary diffuser (frictionless and adiabatic) and an annular, supersonic, frictionless, adiabatic secondary ejector. It was found that overall system lengths of the order of 50 or 60 feet were compatible with a diffuser starting at engine chamber pressures as low as 50 to 100 psia and engine compartment pressures (prior to engine startup) of the order of 1 psia. Parameter surveys

were conducted of initial duct area, primary diffuser exit area, and secondary ejector parameters. A comparison was made between the ejector-safety-purge concept utilized in ETS-1 and several stored inert-gas standby safety purge systems. It was found that stored, unheated nitrogen systems required excessively high pressures and flow rates, principally because of nitrogen's low characteristic velocity (To/M) at ambient and lower temperatures. A stored-gas standby safety purge system utilizing liquid nitrogen storage and a packed-bed preheater similar to that used in TORY reactor testing was found to be feasible, and may be compared directly with the ETS-1 continuous safety-purge concept. Response times for the stored-gas standby system were found to be of the order of 100 milliseconds, and therefore appear suitable for emergencies caused by catastrophic engine shutdown. Non-conventional diffusers, particularly fluid-jet concepts, are discussed briefly, and although these are sufficiently interesting to warrant research for future applications, they are too far from state-of-the-art to be considered for initial NERVA-II testing. (auth)

35445 (TID/SNA-1551) NRX/EST PERFORMANCE EVALUATION DRAGON MEMORANDA, EP IV. (NERVA Test Operations, Jackass Flats, Nev. (USA)). Mar 1966. 208p. Dep. NTIS $13.50.

Experimental plan IV of the NRX/EST series was performed at test cell A, NRDS, on March 16, 1966. Two bootstrap startups at low dewar pressure (45 psia) with the control drums in fixed positions were successfully accomplished. The first startup was terminated by automatic flow shutdown after the pressure control loop was closed. The pressure control closure was inadvertently delayed until the actual chamber pressure was 163 psia, which was considerably higher than the 50 psia demanded pressure. Normal operation of the pressure control loop to correct the error produced a loss of flow signal that resulted in the flow shutdown. The second bootstrap startup continued to approximately full power, where transfer function measurements were made. Operation from the full power region to the planned tie rod exit gas temperature at a constant chamber temperature of 4000 degrees R, followed by programmed chamber temperature shutdown at constant TPCV position was accomplished. The run was terminated because the minimum required liquid hydrogen level was reached. The planned objectives were: To demonstrate bootstrap startup capability at low dewar pressure; to operate at high power, 1050 megawatts or greater, for an extended time to be determined by the test cell A liquid hydrogen capacity; to achieve those objectives of previous EP's that were planned but not met; to determine additional (high power) NRX/EST system dynamic characteristics; to obtain additional data for improvement of analytical models; and to gain increased confidence in the maneuverability of the NRX/EST within its operating envelope. Most of these objectives were met. A few anomalies are still being investigated. (auth)

35446 (TID/SNA-1557) OUTLINE OF FACTORS SIGNIFICANT TO THE DEVELOPMENT OF NUCLEAR ROCKET ENGINES UTILIZING FAST REACTORS. Report No. AG-11. Grey, J. (Aerojet-General Corp., Azusa, Calif. (USA)). 8 Dec 1962. 14p. Dep. NTIS $4.00.

The problems of applying nuclear propulsion systems employing fast reactors to a specific range of space missions have been outlined. The missions were categorized by orbital (or boosted) startup, 30,000-lb payload, and 50,000 ft/sec velocity increment, with initial accelerations of 0.1 to 0.3 earth gravity. The tradeoff between nuclear engine weight and specific impulse was estimated, and at the selected mission conditions was about 100 lb of weight per second of specific impulse. Dependency requirements of gross weight and reliability on the various reactor and engine parameters were outlined, but were too extensive to calculate at this time. It was concluded that these parameter studies must be performed for fast reactors of two general classes (tungsten–UO_2 and metallic carbide–UC), as well as for the water-moderated (thermal) tungsten reactor and possible developments under the PHOEBUS program, prior to initiation of a full-scale engine development program of NERVA proportions. (auth)

35447 (TID/SNA-1563) NERVA ENGINE ASSEMBLY PROCEDURES. (Aerojet-General Corp., Sacramento, Calif. (USA)). 7 Dec 1962. 53p. Dep. NTIS $5.75.

35448 (TID/SNA-1588) SNP-1SA3 CONTRACT MONTHLY LETTER REPORT FOR THE PERIOD 27 NOVEMBER 1963–26 DECEMBER 1963. Peterson, J. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). Dec 1963. 113p. Dep. NTIS $8.75.

Progress in the NERVA engine development program is reported. (JWR)

35449 (TID/SNA-1601) PROGRAM PLAN: NRX-A NOZZLES WITH AREA RATIO 4. Subtask 1.4. Peterson, J. J. (Aerojet-General Corp., Sacramento, Calif. (USA)). 10 Jul 1963. 14p. Dep. NTIS $4.00.

35450 (TID/SNA-1605) SNP-1SA3 CONTRACT, MONTHLY LETTER REPORT. (Aerojet-General Corp., Sacramento, Calif. (USA)). Jan 1964). 92p. Dep. NTIS $7.75.

Progress in the NERVA engine development program is reported. (JWR)

35451 (TID/SNA-1616) DRAGON-3 DAILY SUMMARY MEMO NO. 5. Wasserman, A. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 13 May 1965. 31p. Dep. NTIS $4.75.

The results of NRX-A3 flow tests and scaled down power tests are presented. (JWR)

35452 (TID/SNA-1617) INTEGRITY OF NRX-A3 TEST ASSEMBLY BASED ON EP-IIIA FLOW AND PRESSURE DATA. Boman, L.; Lance, J. R. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 May 1965. 4p. Dep. NTIS $4.00.

35453 (TID/SNA-1619) DRAGON-3 DAILY SUMMARY TWX NO. 7. Wasserman, A. A. (Aerojet-General Corp., Sacramento, Calif. (USA)). 15 May 1965. 2p. Dep. NTIS $4.00.

The results of NRX-A3 Dragon team efforts on EP-IIIA tests are reported. (JWR)

35454 (TID/SNA-1642) NERVA REMOTE HANDLING SYSTEM, SUMMARY TECHNICAL REPORT FOR THE PERIOD OCTOBER 1, 1962–SEPTEMBER 30, 1963. (AMF Atomics, Greenwich, Conn. (USA)). 15 Nov. 1963. 71p. Dep. NTIS $6.75.

For Aerojet-General Corp., Azusa, CA.

35455 (TID/SNA-1644) DRAGON MEMORANDA, EST 160–187. NRX/EST, EP-IV. (Aerojet-General Corp., Sacramento, Calif. (USA)). [nd]. 210p. Dep. NTIS $13.50.

An evaluation of the performance of the NRX/EST System upon conclusion of Experimental Plan IV is presented. (JWR)

35456 (TID/SNA-1651) BENDIX CORPORATION RESEARCH LABORATORIES DIVISION SUPPORT DOCUMENTATION FOR NERVA PROGRAM. Period 11 January 1962–30 June 1962 and Period 1 July 1962–30 September 1962. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1962. 98p. Dep. NTIS $8.00.

Some cost data and some information on planned activities in the NERVA program are presented. (JWR)

35457 (TID/SNA-1675) IRRADIATION TEST, PRELIMINARY REPORT. Pou, C. G.; Guinn, J. W. (General Dynamics/Fort Worth, Tex. (USA)). 24 Oct 1963. 73p. Dep. NTIS $6.75.

Continuing work on the irradiation testing of NERVA turbopump assembly bearings in a liquid hydrogen environment is reported. (JWR)

35458 (TID/SNA-1676) IRRADIATION TEST, PRELIMINARY REPORT. Guinn, J. W.; Pou, C. G.; Wachowski, J. S. (General Dynamics/Fort Worth, Tex. (USA)). 18 Dec 1964. 75p. Dep. NTIS $16.75.

Continuing work on the irradiation testing of NERVA turbopump assembly bearings in a liquid hydrogen environment is reported. (JWR)

35459 (TID/SNM-4) NUCLEAR ROCKET UNCOOLED NOZZLE STUDY PROGRAM. Monthly Report, 1 March–31 March 1970. (Aerojet-General Corp., Sacramento, Calif. (USA)). Apr 1970. 12p. Dep. NTIS $4.00.

The objective of this Uncooled Nozzle Study Program was to study the feasibility of substituting an "uncooled" nozzle (radiation-cooled) for the current NERVA regeneratively-cooled nozzle, and to determine its effect on performance and reliability. The nozzle designs considered were aimed at preventing credible nozzle failures that could result in loss of engine performance or a catastrophic accident. Internal heat generation due to gamma attenuation was also considered. At a status review, the results were presented and a follow-on program was discussed. The material verbally presented included the program summary, recommendations, nozzle selection and nozzle attachment tradeoffs, results of the thermal and structural analysis, and the chemical compatibility of graphite materials and alloys with hydrogen. (auth)

35460 (TID/SNW-5) WANL XE-1 CONTROLS READINESS REVIEW, MARCH 7 AND 8, 1968. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 57p. Dep. NTIS $6.00.

Slides presented at a Controls Readiness Review have been documented. The status of the Test Stand Control System for Engine Test Stand No. 1 is presented, along with a description of the control system and a few problem areas. (LTN)

35461 (TID/SNW-19) NUCLEAR SUBSYSTEM SUBPOWER RANGE START-UP REQUIREMENTS. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 64p. Dep. NTIS $6.25.

35462 (USNRDL-TR-1010) ROVER FLIGHT SAFETY PROGRAM PRELIMINARY REVIEW. IV. Safety Analysis Report: Radiological Considerations in Nuclear Flight Safety. (Naval Radiological Defense Lab., San Francisco, Calif. (USA)). 20 Apr 1966. 178p. Dep. NTIS $12.00.

Accidents to space nuclear porpulsion systems could lead to deposition of radioactive material on the surface of the earth and subsequently to interactions between man and the radioactive debris. Preliminary models are developed to evaluate possible safety problems resulting from the introduction of nuclear rocket debris into man's environment. The physical and chemical characteristics of the debris are described as well as general exposure criteria and applicable biological effects information. The concept of probability of exposure as a relevant safety index is employed. Mathematical models are presented which describe the likelihood of different levels of total body gamma exposure experienced by a mobile receptor and the expected number of direct interactions between people and debris. For direct interactions, skin, lung, and gastrointestinal tract exposures are specifically considered. Beta and gamma dose calculational methods applicable to reactor debris problems have been developed as part of these studies and are described in detail. (auth)

35463 (WANL-TME-541) PRELIMINARY WANL EVALUATION OF THE NUCLEAR INSTRUMENTATION FOR THE NRX-A CONTROL SYSTEM. Gilmour, G. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1963. 17p. Dep. NTIS $4.00.

The nuclear instrumentation is adequate for NRX-A requirements with the exception that it does not have a restart capability during the period immediately following reactor shutdown. A restart capability will not be required until the NRX-A-4 reactor according to present program planning. The nuclear instrumentation has been designed for flexibility in incorporating such a capability when the circuitry is developed. The system can be improved with respect to R-F noise sensitivity and incorporation of improved radiation resistant preamplifiers. Effort is being carried on in these areas. (auth)

35464 (WANL-TME-761(Add. 1)(Suppl. 1)) NRX-A2 SAFETY EVALUATION REPORT, WANL-TME-761. Hemmerle, E. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 Jul 1964. 2p. Dep. NTIS $4.00.

Due to a delay in delivery of the nozzle, NRX-A2 preparatory operations have been revised to improve scheduling so that the reactor will now be transported to the test stand with the poison wire system intact. The poison wire system will be removed there according to previously developed procedures. A nozzle end closure for the pressure vessel will be installed to prevent accidental introduction of material into the reactor. Installation of the nozzle and its associated instrumentation after initial criticality will not introduce any new safety problems. (LTN)

35465 (WANL-TME-790) FACILITY FLUID ADDITIONS FOR VARIOUS OPERATING TIMES OF NRX REACTORS UP TO 20 MINUTES OF EQUIVALENT FULL POWER OPERATION. Goldberg, S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 May 1964. 11p. Dep. NTIS $4.00.

The additional storage requirements of gaseous and liquid hydrogen needed for 20 minutes of NRX engine testing at test cell A are estimated. Existing storage capacities for gaseous helium and nitrogen at 500°R and of gaseous nitrogen at 200°R are adequate for 20 minutes of engine testing. (LTN)

35466 (WANL-TME-1123) ANALYSIS AND DESIGN OF NRX-A3 LIMITER CIRCUITS. Josephson, J.; Gurski, P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Mar 1965. 53p. Dep. NTIS $5.75.

Analog computer studies of limiter circuits for use on the NRX-A3 reactor have been performed. These studies show that simple limiter circuits can be devised which protect the reactor from reasonable system malfunctions or unexpected perturbations in power, flow or temperature. These limiters are not required for adequate nuclear safety but they do improve the ability of the control system to protect the reactor from damage resulting from system malfunctions. Taken one at a time, each of the four limiters (power, temperature, period and tie rod) was stable and performed the function as predicted. Many combinations of the limiters were studied and in all cases of moderate system malfunctions the four limiters exhibited the expected limiting action. For severe system shocks, such as large power step demands, interaction of the period limiter caused limit cycle operation. By removing the period limiter the limit cycle was eliminated. However, the initial power excursion from the larger step demands exceeded 200 percent power which would have activated the fixed power scram. Even during the limit cycle operation the limiters functioned to keep the system variables within the limited values. Although it would be possible to improve the period limiter circuit design it is felt it is not required at this time. It is recommended that the tie rod, core temperature and power limiters be checked out and used on NRX-A3. (auth)

35467 (WANL-TME-1126(Add. 1)(Suppl. 2)(Rev. 2)) WANL-TME-1126: SUPPLEMENT 2. Revision 2. Addendum 1. Hemmerle, E. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Dec 1965. 3p. Dep. NTIS $4.00.

When the turbopump did not start in a planned test even when the Dewar pressure was raised to 70 psia, it was considered necessary to estimate what would happen to the engine if the pump started suddenly with such a high gas pressure. While the system performance under these abnormal conditions could not be predicted exactly, it was estimated that the effects on reactivity would not be serious especially if the engine was not over-cooled. A constraint on the total integrated flow permitted without pump rotation will be incorporated. (LTN)

35468 (WANL-TME-1126(Suppl. 3)(Add. 2)) REDUCTION OF PERIOD SCRAM SETTING FOR EP-IIC FROM 0.3 SEC TO 1.0 SEC. Hemmerle, E. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 3 Feb 1966. 3p. Dep. NTIS $4.00.

The justification for a proposed reduction in the period scram setting for NRX/EST in Experimental Plan IIC is presented. (JWR)

35469 (WANL-TME-1153) EFFECTIVENESS OF VERTICAL SHIELDS IN A CLUSTER OF THREE NERVA II MODULES. Ricks, L. O. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1965. 45p. Dep. NTIS $5.25.

The primary conclusions obtained from the present survey study and a preliminary investigation of shielding system weight optimization are: (1) The propellant nuclear heating rate can be reduced by 84% with an optimum weight of about 6000 pounds for the top shadow shield and its extension. (2) The propellant nuclear heating rate can be reduced by 90% with an optimum weight of about 7000 pounds for the top shadow shield, extension, and side shield. (3) Side shields must be employed for the nuclear heating rate reduction greater than 91%. (4) Of the three materials considered (lead, steel, and lithium hydride-steel), lithium hydride-steel provides the greatest attenuation per pound in the top shield extension. (auth)

35470 (WANL-TME-1163) ORBIT START APPLICATIONS OF NERVA AND ADVANCED NERVA ENGINES. Dickson, P. W. Jr. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1965. 20p. Dep. NTIS $4.00.

No decision has been reached as yet on specific requirements for nuclear rocket engines to be used for NASA missions. These requirements will ultimately depend on the use to which the engine is to be put, the booster vehicle available, the cost and reliability of the engine, and the time at which the engine could be made available. In order to evaluate the importance of engine thrust, weight, and specific impulse in the performance of a given mission, WANL has developed a computer code that determines the payload put into a lunar or planetary transfer trajectory starting from earth orbit with a given engine and stage weight. Results obtained with this code for some selected missions using several nuclear engines are presented. All of the comparisons assume the use of a Saturn V launch system. (auth)

35471 (WANL-TME-1194) DEVELOPMENT OF PRESSURE TRANSDUCERS FOR INTERNAL MOUNTING AND PRESSURE TRANSDUCER REQUIREMENTS FOR CONTROL (PRESENTED AT THE NERVA INSTRUMENTATION REVIEW MEETING AT WANL ON JUNE 9 AND 10, 1965). Malick, F. S.; Mackey, L. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Jun 1965. 27p. Dep. NTIS $4.50.

The Wiancko transducer will perform with the required accuracy for all environmental conditions called for in the specification, except that it is limited to applications not exceeding 3.0 watts per gram instead of at the four watts per gram level. Thus, we have a transducer which will operate on the dome side of the shield and not on the core side of the shield. This limits the frequency response to about 50 cps instead of the desired 1000 cps. A number of small changes might be made in the Wiancko unit. For even these seemingly small changes, one year of development work will be required to redesign the Wiancko or to resolve the temperature drift problem in the Physical Sciences transducer and complete the testing needed to bring us to a state of knowledge comparable to that of the current models of the transducers. We

feel that we have a good chance of success to make this last small improvement and recommend that this last step be undertaken if there is a reasonable need for high frequency response pressure measurements. These high frequency measurements would be necessary for the analysis of vibration problems, should such trouble arise on any future reactor such as the XE-1 which is down firing and therefore presents a different vibration situation than the present downward firing NRX reactors. (auth)

35472 (WANL-TME-1505) AGC/WANL OPERATION MANUAL. Section III. Technical Interfaces. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 8 Sep 1966. 54p. Dep. NTIS $5.75.

The purpose of this section of the Westinghouse/Aerojet Operational Procedure Manual is to delineate the responsibilities and to define the decision authority of the two organizations in the technical areas and to describe the interfaces that exist by the nature of the close relationship between the efforts of the two organizations in conducting the NERVA Program as implemented by Contract SNP-1 and Subcontract NP-1, and any follow-on contracts as well as to define the method of operation in the technical areas in the Rover Program. It is not the intent of this document to detail all functions and responsibilities of Westinghouse and Aerojet nor to detail the relationship between Westinghouse/Aerojet and SNPO and with the various other participants in the complete Rover Program. Rather it is the intent to define the various interfaces between Westinghouse and Aerojet and their respective authorities and responsibilities and to provide guidelines to the Aerojet and Westinghouse technical managers, supervisors, and personnel for their guidance in conducting the NERVA Program and for interfacing with SNPO and with other Rover Program participants. The scope of the agreements covered by this section includes all technical and programmatic interface aspects of the NERVA Program excluding only those items covered in the administrative and NTO sections of this Operational Procedure Manual. (auth)

35473 (WANL-TME-1526) VARI-QUIR III: INCLUSION OF THE R-THETA GEOMETRY. Collier, G.; Riese, J. W.; Gray, W. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1966. 85p. Dep. NTIS $7.25.

A new version of VARI-QUIR III permits the calculation of R-O geometries with periodic boundary conditions. Also, the new code has complete variable dimensions at execution time. (auth)

35474 (WANL-TME-1578) DESIGN CRITERIA FOR XE-1 ENGINE MOUNTED NUCLEAR DETECTOR (EMND). Schatz, R. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 2 Mar 1967. 18p. Dep. NTIS $4.00.

Basic design criteria are provided for an engine-mounted neutron detector for XE-PRIME. Cooling is to be accomplished without use of LH_2 propellant. Many other specifications apply. (LTN)

35475 (WANL-TME-1689) COMPUTER PROGRAM FOR CALCULATING THE BOUNDARY LAYER PROPERTIES ALONG THE SURFACE OF TURBOMACHINERY BLADES. Fentress, W. K. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 1 Nov 1967. 27p. Dep. NTIS $4.50.

For Jet Propulsion Lab., Pasadena, CA.

A computer program for calculating the boundary layer properties along the suction and pressure surface of turbomachinery blades is described. These properties include the momentum thickness, displacement thickness, full thickness, and the form factor. A necessary input to the program is the surface velocity at a number of points on the suction and pressure side of the blade. The calculation is by the method of Truckenbrodt, but assumes that the boundary layer is turbulent along the entire blade surface. This assumption is justified in turbomachinery, but not in the case of cascades. (auth)

35476 (WANL-TME-1698) USER'S MANUAL FOR THE LIST OF PARTS. Laub, C. W.; Wells, B. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Sep 1967. 48p. Dep. NTIS $5.50.

Early in the development of the NERVA reactors, the need for a flexible parts control system was recognized. Since there are several hundred parts in a reactor, any of which are subject to one or more revisions, it is imperative that a record of the revision released for a given reactor be readily available. For such a system to be effective, it must be: Accurate, easy to understand, easy to update and issue, and timely. WANL developed a computerized parts list system which could meet these requirements. The purpose is twofold: (1) to provide general information for users of the List of Parts (LOP) output and (2) to provide detailed instructions for the preparation and maintenance of a LOP. This manual describes the LOP and relates it to the engineering release system. The LOP system consists of two major printouts: (1) The List of Parts and (2) the Work Copy. The List of Parts is arranged in an indented format and is used for part number control. Since it shows all detail parts in their proper relationship to subassembly and assembly drawings, it is frequently referred to as the "Christmas Tree." On the other hand, the Work Copy is a listing of part number information arranged in part number sequence. The computer program tabulates every entry for each part number and calculates the total quantity requirements. Since each entry for a given part shows where the part is used (in its next higher assembly), the Work Copy also serves as an index for locating all of the assemblies that use a particular part number. Although the Lists of Parts are normally constructed before the assembly drawings are available, the assembly drawings are later used to check the List of Parts information. The Engineering Change Order (ECO) system is the communications media for the LOP. It is used to release or revise information contained in the Lists of Parts. All information must be authorized by an approved ECO before the information can appear in a List of Parts. This is a cardinal rule which must not be violated if the List of Parts is to be a meaningful document. Details of the ECO procedure can be found in the WANL Divisional Procedures Manual and in the report, WANL-TMI-1823. (auth)

35477 (WANL-TME-1729) PROCEDURE FOR USING THE COMPUTER CODE OF NASA CR-710 TO OBTAIN THE TWO-D AXISYMMETRIC FLOWS BEHIND BLADE ROWS IN WET VAPOR TURBINES. Milton, J. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1967. 134p. Dep. NTIS $9.75.

In conjunction with NASA CR-710, this report will give the user sufficient information so as to be capable of utilizing the NASA Performance Computer Code for Axial Flow Turbines as modified at WANL. The modified code is written entirely in FORTRAN IV for the CDC 6600 computer. But the code should be capable of being used with appropriate control cards on any computer having at least 32 K of core storage. No attempt is made to discuss the method of calculation of turbine performance or to give computer flow diagrams since these topics are adequately covered in Reference (1). The modifications made to the code do not significantly change the original program logic or capability; for the most part they were necessary to enable the code to calculate accurately wet vapor turbine performance. Ideal gas turbines can still be analyzed as well as air breathing fossil fuel burning turbines for which the code was originally primarily designed. (auth)

35478 (WANL-TME-1974) GDP: GENERALIZED DOCUMENT PROCESSING. LaPointe, F. J. Jr. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Oct 1969. 98p. Dep. NTIS $8.00.

Generalized Document Processing, GDP, is a Fortran IV program written for the CDC6600 computer. GDP is used to store and list information about a document including subject or title, references, abstracts, and key words. GDP is general in the scope of documents that may be treated and the type of information that may be recorded within three optional formats of document numbers. There are three variables or indexes which may be described by the user and which provide sort options in GDP. In addition, different sorts by document number and date may be specified. Only the title or subject, date, and indexing variables are shown for the indexed listings. These abbreviated listings are referred to as the INDEXES. A more complete listing of each document may also be obtained and in sequence by document number including title, date, indexing variables, references and an abstract. The more complete listings are referred to as the ABSTRACTS. Thus the user may search the INDEXES for pertinent documents and then refer to the ABSTRACTS for a more complete description. A document may be revised in GDP in the following ways, or both: By attaching a revision suffix to the document number and recording the new information separately, or by revising the information already entered for a document. The revision suffix would be used whenever it was important to retain past information, as for traceability. The revision suffix is an integral part of the document number. Therefore, revised document numbers appear in sequence after the main number when sorted by document number as in the ABSTRACTS. (auth)

35479 (WANL-TME-2502) COMPUTER-PROGRAMMED MATHEMATICAL MODEL FOR RELIABILITY. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Jun 1968. 14p. Dep. NTIS $4.00.

Work accomplished to date in developing and implementing a computer-programmed mathematical model for Nuclear Sub System (NSS) reliability analysis is reported. The scope is limited consistent with the stage of development of the program: definition of model requirements, initial model development, application of the model to the NSS, and other uses of the computer model. (auth)

35480 (WANL-TMI-623) GAP MEASUREMENTS BETWEEN CORE ELEMENTS IN A FULL CORE OF NINE-INCH LONG ELEMENTS, BANDED CORE. Appleman, R. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 24 Apr 1963. 7p. Dep. NTIS $4.00.

Gap measurements between core elements in a full complement, nine-inch long core banded around the circumference are presented. This nine-inch core is a transverse slice of a longer full-length core. Measurements were made with feeler gage and shim stock. An average gap between elements in a 60° sector of the core was 0.00052 inch. 72.7 per cent of the gaps measured (or approached) 0.0000 inch. 17.4 per cent measured 0.0015 inch. The average gap near the center of the core was 0.00042 inch, while the average near the periphery was 0.00073 inch. (auth)

35481 (WANL-TMI-842) RESIDUAL ACTIVITY OF NRX-A2 REACTOR COMPONENTS. Ricks, L. O. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 28 Oct 1963. 3p. Dep. NTIS $4.00.

35482 (WANL-TMI-850) DIGITAL COMPUTER PROGRAM FOR INVESTIGATING FLOW INSTABILITIES. Collier, G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Nov 1963. 7p. Dep. NTIS $4.00.

35483 (WANL-TMI-861) NRX, DATA SYSTEMS ACCURACY. Schaedel, C. T. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 11 Nov 1963. 35p. Dep. NTIS $4.75.

This report summarizes accuracy figures for the Data System in use at Test Cell "A," and includes the effects of transducer inaccuracy. The summed accuracies are given along with some background and a bibliography. (auth)

35484 (WANL-TMI-864) TOTAL PERIPHERAL LEAKAGE AREA, ND 201 CORE. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Nov 1963. 2p. Dep. NTIS $4.00.

35485 (WANL-TMI-865) FEED SYSTEM PERFORMANCE, NE8010E. Cemi, S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Nov 1963. 2p. Dep. NTIS $4.00.

35486 (WANL-TMI-873) DATA REQUIREMENTS OF NRX-A REACTOR, VIBRATION AND SHOCK TEST. Buzza, C. V. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 25p. Dep. NTIS $4.25.

The information obtained from the reactor mechanical shock and vibration tests will permit a complete system evaluation and verification of the integrity of the design. Such an evaluation of the reactor is not obtainable from any preceding tests or analyses. A dynamic analysis of each reactor test assembly will be performed. Experimental results obtained will verify the adequacy of the theoretical models, thereby permitting mechanical analysis of reactors with design changes. The response data (transfer functions) from the mechanical vibration tests will be correlated with the cold flow tests and hot runs. The results of the complete reactor mechanical vibration tests should also be correlated with the component test program. Any discrepancies or irregularities should be investigated and resolved. (auth)

35487 (WANL-TMI-881) MEASUREMENT OF NUCLEAR HEATING IN MATERIALS BY USE OF A ROD CALORIMETER. Austin, W. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 3 Dec 1963. 8p. Dep. NTIS $4.00.

The principle of the rod type calorimeter is that the heat energy absorbed in the rod must be conducted down the rod to a heat sink. The temperature gradient along a uniform cross sectional area rod and the thermal conductivity of the rod are sufficient to determine the conductive heat transfer. In the steady state condition, the energy loss is equal to the energy absorbed by the rod from the radiation field. Other heat losses due to convection, conduction, or radiation must be minimal compared to the heat conduction through the rod. (auth)

35488 (WANL-TMI-882) NEUTRON BALANCE CODE FOR P1MG, BAL.-1. Heiser, P.; Woodsum, H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Dec 1963. 15p. Dep. NTIS $4.00.

A comparison study of the P1MG balance code with the DTK code balance check was previously reported. This comparison showed the P1MG and DTK to agree fairly closely in total absorptions and leakage. However, many differences in absorption rates by material were noted which appear to be due, at least partially, to basic cross section differences. It was also noted in running BAL-1 that the total absorptions and leakage do not quite balance out to 1.0 (the normalized fission source). This is believed to be due to numerical analysis difficulties encountered in calculating the radial leakage term which involves a finite difference approximation of derivatives at boundaries. Since the absorptions and end leakage terms do no involve this approximation, a more accurate determination of the net radial leakage is obtained by subtracting the sum of absorption + end leakage terms. The code has also never yet been tried for any geometry other than cylindrical. The code should be thoroughly tested for slab and spherical geometry as well as cylindrical geometry before it can be said to be completely operational. (auth)

35489 (WANL-TMI-892) CALCULATION OF TOTAL GAS USAGE FOR NRX-A REACTORS. Rovnak, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Dec 1963. 11p. Dep. NTIS $4.00.

35490 (WANL-TMI-905) TIE ROD LEAKAGE SEAL TESTS. Fix, H. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 23 Dec 1963. 6p. Dep. NTIS $4.00.

Tests to determine the acceptability of a method of eliminating the leakage flow which might occur through the tie rod centering bushing assembly are described. It was found that a continuous rubber washer having a length of 0.178 inches and an interference fit of seven (7) mils on the inside diameter and sixteen (16) to nineteen (19) mils on the outside diameter, will provide the seal required to eliminate the leakage flow which might develop in test G-3 at 200 psi differential pressure. (auth)

35491 (WANL-TMI-906) "O" RING COMPRESSION TEST. Kotulak, F. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 13 Jan 1964. 15p. Dep. NTIS $4.00.

The purpose of this test was to determine load versus deflection characteristics of 15/32 in. diameter rubber O-Ring material. The information obtained from this test will help predict more accurately the load required for installing the reactor in the shipping container. Testing was accomplished by individually compressing each 6 in. sample between two flat surfaces and observing the compression load at varied increments of deflection from 0 to 0.260 in. The load versus deflection curves show the variation in the O-Ring loading values under various conditions. These graphs show that the loading of the rubber O-Ring material drops off through time and what loading can be expected. In effect, this test determines a "K" value or spring constant at various conditions. These graphs also show that the greatest change or "relaxation" in this rubber occurs during the first five minutes, and there is practically no change after 15 hours. For definite load values, the graphs of sample No. 4 should be used in conjunction with the graph of sample No. 5. The data of sample No. 5 plotted on log paper shows the rate of load loss with time. This can probably be safely extrapolated out to 100 hours. It should be noted that this case applies only for static load conditions. Vibrating loads will, in all probability change the relaxation rates. As seen from the sample No. 4 curve, the relaxation (10 minute) increases with load by approximately 10 percent from low load to the maximum load or deflection applied. From these graphs, it is possible to predict the load required for installing the reactor in the shipping container. (auth)

35492 (WANL-TMI-911) CORE BAND TENSILE TEST. Allison, H.; Zibritosky, G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 13 Jan 1964. 7p. Dep. NTIS $4.00.

A tensile test of a possible titanium core band indicated that its strength (4275 lb or a nominal stress of 64,000 psi was more than adequate for the intended applications. (LTN)

35493 (WANL-TMI-917) REQUIRED CONVERGENCE AND Sn ORDER IN DSN CALCULATIONS. Romesburg, C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 20 Jan 1964. 6p. Dep. NTIS $4.00.

This investigation of the sensitivity of the DSN Flux Distribution Code to the size of the convergence criterion and order of Sn approximation represents a first step in understanding how the code can be most efficiently utilized. It is recommended that a more complete study investigate the following: Effects of mesh spacing and number of mesh points; effects of number of up and down scatters; simultaneous effects of number of thermal groups, mesh size and order; and effect of initial eigenvalue on rate of convergence. Although not an object of this study, it was found that running times for similar problems often vary considerably because the computer is not immediately restarted after programmed stops. This is relected in inconsistencies in running times for similar problems. The use of a Sn approximation of order 4 is recommended on the basis that an S8 approximation gives negligibly better precision while requiring considerably more computational time. Use of an S2 approximation was also investigated but was found to be noticeably different in reactor eigenvalue and power distribution as compared with the S4 approx-

imation. Through communication with D. W. Drawbaugh the conclusion was reached that the DTK Flux Distribution Code could advantageously replace DSN. DTK is essentially the same as DSN with the important difference that it does converge on the eigenvalue. Thus DTK problems should not suffer from the variability resulting from different initial eigenvalue guesses. (auth)

35494 (WANL-TMI-937) DIGITAL DYNAMIC REACTOR-II. Dickson, P.; Drawbaugh, D.; Riese, J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 21 Jan 1964. 5p. Dep. NTIS $4.00.

Some computer results are mentioned and other possible calculations suggested. Heat transfer and fluid flow time constants of ROVER type reactors have been analyzed and then, based on the analysis, numerical values of these constants calculated for NRX-A reactors. It is suggested that reactor kinetics and stability analyses can be verified if the results of appropriate experiments can be predicted. For example, it is suggested that the comparison with the results of point to point transfer functions calculated by the VARI-QUIR program could be usefully compared with corresponding oscillation experiments carried out in the flexible critical facility. (LTN)

35495 (WANL-TMI-946) DOME END SUPPORT RING PRE-IRRADIATION TEST. Kotulak, F. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Feb 1964. 19p. Dep. NTIS $4.00.

Pre-irradiation mechanical tests of the Dome End Support Ring were carried out to establish that the test rig could import the required stresses to the test specimen, to develop a cooling system which would meet the temperatures required (-210°F), and to verify that the test specimen was adequate and suitable for irradiation. When the required stresses could not be obtained with the test rig received from Test Planning, the rig was modified to produce higher stresses, which satisfied Test Planning although they did not equal the original Test Planning requirements. (LTN)

35496 (WANL-TMI-963) NRX-A1 REACTOR SHIPPING REPORT. Davis, R. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Mar 1964. 73p. Dep. NTIS $6.75.

The NRX-A1 reactor was shipped by rail on November 14, 1963 from Large, Pennsylvania to Las Vegas, Nevada arriving on November 18, 1963. On November 19, 1963 the reactor was transported by tractor-trailer to NRDS - Jackass Flats, Nevada from the Las Vegas railhead. During the entire shipment acceleration and displacement data were continuously recorded from transducers installed in the reactor and shipping container. A receiving inspection examination of the reactor indicated that the reactor had not sustained damage or excessive vibration during the shipment. Preliminary examination of the instrumentation data, included in Section VII of this document, confirms that the reactor accelerations encountered from the transportation environment were of low magnitude. It is concluded that the methods and procedures used to ship NRX-A1 are adequate to protect this type of assembled reactor from sustaining damage during rail shipment to Las Vegas, Nevada and truck shipment from Las Vegas to NRDS. (auth)

35497 (WANL-TMI-983) GALLING OF FUEL CLUSTER ATTACHMENT HARDWARE. Kotulak, F. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1964. 21p. Dep. NTIS $4.25.

Methods of minimizing and/or preventing seizure or galling of the tie bolt threads or the mating fuel cluster nut threads during disassembly for post-mortem inspection after hot engine tests were investigated. This disassembly will have to be done by remote handling methods and, if difficulties were encountered which made destructive disassembly necessary, the post-mortem inspection would be meaningless. In the experimental tests silver-plated and "Tuftrided" threads performed well without galling or seizure under normal and twice normal torque loads and temperature cycling (LN_2 to 500°F). One assembly of a plain/nut combination did fail by galling and seizure. (LTN)

35498 (WANL-TMI-1006) TORQUE TESTS ON INSTRUMENT PARTS, SEAL LOCKING DEVICES. Zibritosky, G.; Allison, H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1964. 8p. Dep. NTIS $4.00.

The results of tests conducted on a proposed dowel pin compression ring locking device for the NRX-A1 reactor are presented. (JWR)

35499 (WANL-TMI-1023) FOLLOW-UP ON CORE BAND ASSEMBLY EVALUATION. Appleman, R. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 11 Jun 1964. 1p. Dep. NTIS $4.00.

The feasibility of assembling a double coupling joint core band for the NRX-A2 reactor is stated. (JWR)

35500 (WANL-TMI-1027) MECHANICAL DESIGN EVALUATION OF LOOSE TIE RODS IN THE NRX-A1. Schlitt, W. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1964. 5p. Dep. NTIS $4.00.

35501 (WANL-TMI-1085) NRX-A2 MATERIAL LIMITATIONS. Lescisin, J. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 May 1964. 2p. Dep. NTIS $4.00.

35502 (WANL-TMI-1091) OUTER REFLECTOR SECTOR THERMAL SHOCK TEST FEASIBILITY STUDY. Zemanick, P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 May 1964. 7p. Dep. NTIS $4.00.

It was proposed to subject a full size NERVA outer reflector sector to severe temperature gradients comparable to those predicted for reactor startup conditions. The first scheme proposed was to immerse the sector in liquid nitrogen. When calculations showed the immersion scheme incapable of producing required gradients, the analysis was expanded to include forced convection cooling. The results of the analysis are presented. (auth)

35503 (WANL-TMI-1111) RETURN SHIPMENT OF NRX-A1. Figenbaum, E. K. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jun 1964. 10p. Dep. NTIS $4.00.

35504 (WANL-TMI-1124) NORMALIZATION FACTORS FOR NUCLEAR DESIGN CODES. Sipush, P. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 5 Jun 1964. 5p. Dep. NTIS $4.00.

Power and flux normalization factors for all the transport and diffusion codes used for NERVA nuclear analysis and design are tabulated. (JWR)

35505 (WANL-TMI-1154) NOZZLE INTERFACE SEAL. Libbing, S. V. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jul 1964. 6p. Dep. NTIS $4.00.

An investigation into failure of the NERVA nozzle interface seal is described. (JWR)

35506 (WANL-TMI-1157) COMPARISON OF THE S_2 AND S_4 APPROXIMATIONS IN THE DTK TRANSPORT CODE. Nelligan, M. D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 30 Jun 1964. 6p. Dep. NTIS $4.00.

The S_2 approximation seems nearly as adequate as S_4 for eigenvalue calculations and gives close agreement for power shape; it should be quite useful for reactivity coefficient calculations of a survey nature. Computer running time could be nearly cut in half by use of the S_2 approximation, particularly if a convergence criterion of .0001 were used. For accurate final calculations, however, S_4 is recommended. In comparing S_2 and S_4 results with the AIM-5 diffusion code, for 4 group calculations, it was found that the S_2 results were considerably more consistent with the S_4 results than with the diffusion theory results for all cases examined. (auth)

35507 (WANL-TMI-1424) ANALYSIS OF PROPOSED SHIELD SEAL REDESIGNS. Stancampiano, P. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 17 Mar 1965. 9p. Dep. NTIS $4.00.

Mathematical analyses of proposed shield seal redesigns for the NRX reactor are compared. (JWR)

35508 (WANL-TMI-1440) DESCRIPTION OF THE DIGITAL ANALYSIS PROGRAMS USED TO ANALYZE THE WIDE BAND TEST DATA. Killinger, A. H.; Saalbach, C. P.; McCune, W. C.; Kocur, R. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 22 Mar 1965. 302p. Dep. NTIS $18.25.

This report describes the digital computer programs which were written at WANL to process the wide band (0 to 1000 CPS) NERVA test data. These programs are the SPIT Program, PLOT Program, and the AUTOCT Program. The input to the SPIT Program is a packed digital tape produced by the WANL Wide Band Data Converter. The SPIT Program performs calibration, tests for linearity of the data recording system, unpacks and converts the voltages from the A-D tape to values with engineering units, calculates interim time values, and generates a magnetic tape containing the time and channel values for the requested time slices. The Plotting Program uses the data generated above to produce a tape which may be plotted on the Stromberg Carlson 4020 electronic plotter. The AUTOCT Program generates a tape with the requested data in a form acceptable to the Huntsville Correlation Program. The Huntsville Program performs spectral analysis of the data. (auth)

35509 (WANL-TMI-1443) GLASS SEALS FOR MOISTURE SEALING INSTRUMENTATION CABLES. Chambers, G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Apr 1965. 23p. Dep. NTIS $4.25.

Developmental work on glass seals for NRX instrumentation cables is described. (JWR)

35510 (WANL-TMI-1471) CALIBRATION AND PROOF TESTS OF THE NRX-A4 LEAF SPRINGS (EML-65). Sucevic, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 Jun 1965. 8p. Dep. NTIS $4.00.

35511 (WANL-TMI-1503) PRIVY ROOF MOUNTED SHIELD VIBRATION ANALYSIS. Persin, W. J. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [nd]. 18p. Dep. NTIS $4.00.

Information based on past reactor test data are used in support of estimating the possibilities of seriously exciting the privy roof mounted shield. Also, preliminary calculations of the fundamental resonant modes of the shield are made. It was found that no major low frequency mechanical excitations to the privy roof exist. Since a relatively low fundamental resonance of 18.8 cps was calculated for the shield, there is no reason to expect this resonant mode to be seriously excited during a reactor test. (auth)

35512 (WANL-TMI-1600) DESCRIPTION AND CHANNEL OPERATION OF ETS-1 DATA ACQUISITION SYSTEM. Vuckovich, M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1965. 172p. Dep. NTIS $11.75.

The purpose of this manual is to describe the general use and operation of the Data Acquisition System at ETS-1 for the use of Westinghouse personnel. Various major subsystems within the data system have been included so that there may be a better understanding of the operation of the entire system. It is anticipated that from time to time, the system may be modified to accommodate the requirements of various tests; therefore, this report is not to be considered complete in every detail and may be modified frequently as needed. Only a few schematics have been included; the vast number of subsystem schematics would make it prohibitive to include them all in this manual. Detailed information on subsystems may be found in the various manuals of each subsystem; these manuals have been referenced at appropriate places throughout this report. Excerpts from these manuals have been included to aid the general description of operation of the equipment where it appeared they might prove helpful. (auth)

35513 (WANL-TMI-1613) CONVERSION OF OUR DIGITAL COMPUTER PROGRAMS TO THE INTERIM AND INTERCOMP COMPUTERS. Saalbach, C. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1965. 31p. Dep. NTIS $4.75.

The planned replacement of the 7094 by an "Interim Computer" in the fall of 1966, and the possible replacement of this "Interim Computer" by the "Intercomp Computer" sometime in 1967 is discussed. Also included is a brief discussion of some of the problems and oppor unities, which will result from these new computers. The remainder of the report is to serve as a working document for programmers, whose duty it will be to convert programs to the new computers. Both management and programmers are encouraged to call upon Physics and Mathematics or the Digital Computing Facility for any further advice, in order that conversion can be done with minimum effort and cost. During conversion, one of the important objectives should be the declassification of all possible program data. This is a particularly important problem if efficient use is to be made of the Intercomp computer, since programs as well as input and output will be stored on discs and other mass storage devices which will be used by all of Westinghouse. An additional security problem is the sending of input and output over telephone lines between Astronuclear and the Intercomp computer site. (auth)

35514 (WANL-TMI-1617) RADIOCHEMICAL ANALYSIS OF NRX-A3 NOZZLE SMEAR SAMPLES. Henninger, W. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Dec 1965. 12p. Dep. NTIS $4.00.

Radiochemical analyses were performed on six smear samples taken from the inside surface of the NRX-A3 nozzle. The purpose of taking these smears was as follows: (1) To identify the radionuclides contributing to the radiation on the nozzle surface and to determine the absolute disintegration rate of each; (2) To estimate the amount of fission product plate out on the nozzle; and (3) To compare the results with those of the NRX-A2 nozzle. (auth)

35515 (WANL-TMI-1620) RELIABILITY ASPECTS OF XE-1 ACTUATOR DESIGN REVIEW. Ottenheimer, F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 29 Dec 1965. 6p. Dep. NTIS $4.00.

Proposed actuator design changes and a proposed change of facility for actuator assembly work are discussed. (auth)

35516 (WANL-TMI-1734) DESIGN STUDIES OF TERRESTRIAL REACTOR-ELECTRIC POWER PLANTS IN THE 100 KW(e) RANGE. Selz, A.; Tang, Y. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). [1966]. 30p. Dep. NTIS $4.50.

Several approaches to the use of nuclear reactors for providing electrical power for hardened ICBM launch sites (silos) were investigated. The various plant concepts which were generated and the results of the design effort on the one type pursued to the point of preliminary design are presented. (auth)

35517 (WANL-TMI-1777) A-6 LATERAL SUPPORT SPRING TEMPERATURE-LOAD TEST. Solie, W. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 26 Apr 1967. 11p. Dep. NTIS $4.00.

35518 (WANL-TMI-1829) Q. C. TENSION TESTS OF XE-2 INCONEL 718 TIE RODS. Rostand, L. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Sep 1967. 2p. Dep. NTIS $4.00.

35519 (WANL-XE-SA-319) XE-PRIME, EP-IVA TRANSFER FUNCTION MEASUREMENTS. Noe, D. E. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 31 Jan 1969. 101p. Dep. NTIS $8.25.

Wide band data from EP-IVA of the XE-PRIME Test Series has been processed to obtain transfer functions. The channels processed are identified and operating conditions, time history plots and transfer functions plots given. (LTN)

35520 ANNUAL REPORT ON THE N. S. MUTSU FOR THE FISCAL YEAR 1972. Nippon Genshiryokusen Kaihatsu Jigyodan Nenpo; No. 972, 1-51(Dec 1973). (In Japanese).

Following fiscal 1971, various works have been performed on the nuclear ship "Mutsu," the first nuclear powered ship in Japan, in the fiscal year 1972. These activities are described as follows: the test of reactor functions, the loading of nuclear fuel, the preparation for reactor power test, the maintenance of home port, and crew training. The functional test of the reactor plant in warmed-up condition was completed, and the reactor plant was taken over officially from its maker. This was immediately followed by the loading of nuclear fuel. Due to the opposition from local fishermen, however, the power test of the reactor plant was impossible. The preparation of the home port proceeded as planned to do subsequent works for the N. S. Mutsu. (JA)

Reactor Safety and Environmental Aspects

Refer also to abstracts 33108, 33137, 33138, and 35617.

35521 (AED-CONF-74-474-003) PROTECTION OF VICTIMS WITHIN THE FRAMEWORK OF COLLECTIVE RESPONSIBILITY ACCORDING TO THE EUROPEAN CONVENTION ON THIRD PARTY LIABILITY IN THE FIELD OF NUCLEAR ENERGY. Some Remarks on Various Problems Regarding the Enforcement of Claims for Damages. Pelzer, N. (Goettingen Univ. (F. R. Germany). Inst. fuer Voelkerrecht). 1974. 1p. (In German). INIS.

From 3rd German symposium on atomic energy law; Goettingen, F. R. Germany (22 Oct 1974).

Although the flaws of the system of joint international liability are considerable with regard to the protection of victims, the ratification of the Convention by the FRG is a step that has to be taken in order to reach the largest possible extent of adjustment or even standardization of the respective national laws, which is the only way of coping with the international character of the atomic risk. One of the most urgent tasks in the near future will be to initiate a comprehensive revision of the international conventions on nuclear liability. The legislation now underway in the FRG will offer some new ideas and approaches for this task. (GE)

35522 (BNL-19763) HTGR SAFETY EVALUATION DIVISION. Summary Report, February 1974–February 1975. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 241p. Dep. NTIS $15.25.

Information is presented concerning fission product release and transport, primary coolant impurities, rapid graphite oxidation, structural evaluation, materials, safety instrumentation and control systems, and accident delineation. (74 references) (DCC)

35523 (CONF-750303-6) FAST REACTOR SAFETY. Avery, R. (Argonne National Lab., Ill. (USA)). Mar 1975. 8p. Dep. NTIS $4.00.

From proceedings on nuclear cross section and technique; Washington, District of Columbia, USA (3 Mar 1975).

Safety aspects of LMFBR type reactors are analyzed. A safety program to study the safety requirements and characteristics of LMFBR type reactors is described. (DCC)

35524 (COO-2294-4) STEAM/WATER INTERACTION IN A SCALED PRESSURIZED WATER REACTOR DOWNCOMER ANNULUS. Crowley, C. J.; Wallis, G. B.; Ludwig, D. L. (Dartmouth Coll., Hanover, N. H. (USA). Thayer School of Engineering). Sep 1974. Contract AT(11-1)-2294. 198p. Dep. NTIS $13.00.

Steam/water countercurrent flow in a $\frac{1}{30}$ scale, flat-plate, plastic model of a Pressurized Water Reactor downcomer annulus was investigated. Various inlet geometries, selected to simulate a number of different real reactor injection arrangements, were studied, as well as three water temperatures. Several types of baffling were used to determine their effect on the penetration of liquid through the annulus. Maps, showing the effects of the various parameters on the "end-of-bypass" in this experiment are presented and discussed. The usefulness of this information in reactor safety studies is also discussed, including tentative scaling laws based on simplified theoretical models. 17 references. (auth)

35525 (EURFNR-1199) REACTOR SAFETY AND PROMPT NEUTRON GENERATION TIME. Thurnay, K. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Nov 1973. Translation of KFK-1881. 22p. Dep. NTIS $4.25.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The aim of this work was to decide if an increase in the prompt neutron generation time can make a given nuclear reactor more or less safe in the case of an eventual accident. The calculations show that for small accidents the reactor safety is not significantly influenced by the generation time. In the case of large, uncontrolled accidents an increase in the generation time turns a reactor less safe, by increasing the destructive energy produced. (17 references) (auth)

35526 (EURFNR-1213) BEHAVIOR OF THE CORE OF A FAST SODIUM-COOLED REACTOR AFTER SERIOUS HYPOTHETICAL ACCIDENTS. Groetzbach, G.; Kussmaul, G.; Meyder, R.; Struwe, D. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Aug 1974. Translation of KFK-1928. 371p. Dep. NTIS $21.75.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The initial situations forming the basis for studies on the retention capacity of the core and the possibility of a second criticality are defined, with reference to the two hypothetical chains of fault conditions taken as the basis. The thermal and hydraulic behavior of the fuel/steel pile within the deformed core structure is defined. The thermal and hydraulic behavior of fuel/steel assemblies is discussed, after which consideration is given to the meltdown of possible fuel/steel assemblies within the deformed fuel channels. The criticality of the configurations resulting from the formation of possible fuel/steel assemblies is analyzed. The thermal behavior of the fuel deposited on the grid plate is discussed. The behavior of the fuel on the bottom of the lower plenum is also discussed. 68 references. (auth)

35527 (GEAP-14023-1) SAFETY ASSESSMENT FIRST PROGRESS REPORT, APRIL–AUGUST 1974. (General Electric Co., Sunnyvale, Calif. (USA). Fast Breeder Reactor Dept.). Sep 1974. Contract AT(04-3)-893. 26p. AT.

The objective of Task 13 is establishment of the basis for safety assessment of LMFBR plants. Work on Task 13, LMFBR Risk Analysis Methods, began in the fourth quarter of fiscal year 1974. Activities during the reporting period included development of a preliminary program plan for meeting the objective. In accordance with the initial phase of the program, other activities included: evaluation of the state of the art of risk analysis methods through literature survey and application to an LMFBR reference plant; development of methods as needed in the above application; and selection of three accident-initiating events leading to local and whole-core transient overpower (TOP) and loss of flow (LOF) for further analysis in the next phase of the program. The program plan and some of the accomplishments during the reporting period are discussed. 28 references. (auth)

35528 (JAPFNR-178) LOSS-OF-FLOW TESTS IN SINGLE- AND SEVEN-PIN GEOMETRIES. Kikuchi, Y.; Haga, K.; Ohtsubo, A. (Japan Atomic Energy Research Inst., Oarai, Ibaraki. Oarai Research Establishment). Nov 1974. 14p. (CONF-741104-5; PNC-N-941-74-74). Dep. NTIS (US Sales Only) $4.00.

From winter meeting of the American Society of Mechanical Engineers; New York, New York, USA (17 Nov 1974).

Work performed under United States–Japanese Fast Reactor Exchange Program.

Loss-of-flow tests have been conducted in single-pin and seven-pin geometries. The incipient-boiling (IB) wall superheat correlates with the rate of the temperature rise. The pressure rise at the initial vaporization compares well with the vapor pressure corresponding to the IB wall superheat. The pressure pulse occurred at the vapor collapse correlates reasonably well with the reentrant velocity of the liquid column and agrees quite well with the theoretical value predicted from the sodium-hammer analysis. The void pattern observed in the single-pin experiments agrees fairly well with that calculated by the NAIS-P2 code (single-bubble slug-ejection model), whereas in the seven-pin experiments, the two-dimensional voiding pattern is dominant. The thickness (0.05 mm and 0.45 mm) of the residual liquid film becomes thinner with higher IB wall superheat. (8 references) (auth)

35529 (JUL-1098-RG) CONTAINMENT FOR HIGH-TEMPERATURE REACTORS UNDER SPECIAL CONSIDERATION OF SAFETY AND ENVIRONMENTAL ASPECTS. Kroeger, W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (F. R. Germany)). Aug 1974. 92p. (In German). INIS.

The importance of both the HTR containment and its arrangement to ensure safe HTR operation without environmental burdens is examined. Requirements and problems are identified, and solutions are indicated. It is shown that the total release path of radioactive fission products, the outlets, and the releases are each determined at different conditions. The behavior of the containment under extremely high external influences is discussed. Underground emplacement is indicated as a possibility to handle the heaviest accidents. A lay-out of a process-heat reactor is proposed. (auth)

35530 (KFK-EXT-28/74-2, pp v) EXPECTED BEHAVIOUR OF FUEL RODS IN A LOSS-OF-COOLANT ACCIDENT AND ITS STUDY IN OUT-OF-PILE-EXPERIMENTS. Class, G.; Hofmann, G.; Wiehr, K. 1974. (In German).

From annual colloquium of the Projekt Nukleare Sicherheit; Karlsruhe, F. R. Germany (19 Nov 1974).

In annual colloquium of the Projekt Nukleare Sicherheit.

Three questions regarding possible fuel rod failures are examined: (1) Are the model concepts regarding the fuel rod deformation and danger in the blowdown phase correct? (2) Are the model concepts regarding the fuel rod failure in heating the pressureless reactor core with simultaneous presence of steam and water in the flow phase sufficient? (3) How do the cooling conditions in the reactor core change with cooling channel blockages already present due to cladding, swelling and bursting compared to an undisturbed reactor core. (GE)

35531 (NP-20334 and (Suppl. 1)) STATUS REPORT BY THE DIRECTORATE OF LICENSING IN THE MATTER OF BABCOCK AND WILCOX ECCS EVALUATION MODEL CONFORMANCE TO 10 CFR 50, APPENDIX K. (USAEC Directorate of Licensing, Washington, D. C.). 1974. 183p.

A history of the evolution of the new criteria and the general limitations of the staff review are presented. A discussion of the Babcock and Wilcox ECCS evaluation model and the significant features of the analytical codes employed by Babcock and Wilcox are included. The results of the staff independent calculations and a comparison to analogous Babcock and Wilcox calculations are presented. Each requirement in Appendix K, Babcock and Wilcox conformance and the acceptability of the analytical methods employed in the model are discussed. A separate discussion of the staff's evaluation of the Babcock and Wilcox small break model and the important differences from the large break model are presented. An overall status of current documentation available on the new Babcock and Wilcox ECCS evaluation model is analyzed. (15 references) (auth)

35532 (NTO-I-0364(Rev.1)) NTO INSTRUCTION FOR ETS-1 NEUTRONICS REACTOR SAFETY SYSTEM SET-UP. Revision 1. Final Issue. Noell, H. J. (NERVA Test Operations, Jackass Flats, Nev. (USA)). 10 Jul 1968. 19p. Dep. NTIS $4.00.

Detailed procedures for the setup and checkout of the Neutronics Reactor Safety Systems are presented. (JWR)

35533 (NUS-144) ENVIRONMENTAL SAFETY ASPECTS OF NUCLEAR ROCKET FLIGHT OPERATIONS. Semi-Annual Progress Report. (NUS Corp., Washington, D. C. (USA)). Jul 1963. 111p. Dep. NTIS $8.75.

Computer calculations involving the spread of radiation based on models and meteorological conditions, hazards from reentry fragments, radioactive iodine deposition in launch area, etc. are given. Radiological and biological criteria studies for irradiation by insoluble particles are underway. (LTN)

35534 (NUS-208) ENVIRONMENTAL SAFETY ASPECTS OF NUCLEAR ROCKET FLIGHT OPERATIONS. Semiannual Progress Report. (NUS Corp., Washington, D. C. (USA)). Dec 1964. 65p. Dep. NTIS $6.25.

Efforts conducted under Contract SNPC-6 during the six-month period between May and October 1964 are described. Work was initiated on safety problems associated with effluent from reactor tests at the Nuclear Rocket Development Station (NRDS), Nevada; particularly, with the development of an improved model for prediction of effluent transport and effects from proposed advanced engine tests. In addition, efforts were continued on environmental flight safety problems. Finally, several special assignments were undertaken for SNPO, including the development of destruct fragment velocity distributions, the assignment of individuals to N-2, LASL, and to the NRDS Safety Advisory Panel for the reactor tests at the Nevada site. The Ground Safety activities include: NRDS effluent work; modification and application of the NURSE-1 computer program to the NRDS situation; NRDS Safety Advisory Panel activities; and a preliminary study of effluent decontamination. The Flight Safety activities include: those generated by assignment under the Radiological Effects Working Group; the examination and development of models for the description of particle velocities created by destruct action; and the work on nuclear transient codes. (auth)

35535 (ORNL-TM-4805(Vol. 4)) QUARTERLY PROGRESS REPORT ON REACTOR SAFETY PROGRAMS SPONSORED BY THE NRC DIVISION OF REACTOR SAFETY RESEARCH FOR OCTOBER–DECEMBER 1974. IV. High-Temperature Gas-Cooled Reactor Program. Sanders, J. P. Sr. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 29p. Dep. NTIS $4.50.

The development of an independent capability for predicting HTGR behavior for postulated accidents is described. General-purpose simulators are being developed for the core, steam generator, and turbine-generator plant. Two versions of the POKE code, developed by GAC, were transmitted through BNL. These were made operational on the IBM-360 system, and the sample calculations were executed. (11 references) (auth)

35536 (STH-2/73) REPORT ON THE MONITORING OF THE DISCHARGE OF RADIOACTIVE SUBSTANCES IN THE EXHAUST AIR OF NUCLEAR POWER PLANTS IN THE FEDERAL REPUBLIC. P. 1. Surveillance Installations at the Stack of Nuclear Power Plants with Light-Water Cooled Reactor. Schwibach, J.; Winkelmann, I.; Riedel, H. (Bundesgesundheitsamt, Neuherberg/Muenchen (F. R. Germany). Abt. fuer Strahlenhygiene). May 1973. 66p. (In German). INIS.

Monitoring devices are installed at the stacks of nuclear power plants in order to verify that the approved operating conditions are maintained and to quickly detect abnormal discharges due to incidents in the plant. The release of radioactive substances in the exhaust air must be determined by direct measurement, and minor additions of certain long-lived radionuclides in the exhaust air which are likely to contribute to the radiation exposure of man via ecological processes have to be recorded continuously. A status report is presented which was prepared in cooperation with the operators of the nuclear power plants Kahl, Gundremmingen, Lingen, Obrigheim, Wuergassen and Stade in order to contribute to a planned set of standard measuring regulations for the monitoring of radioactive substances in the exhaust air of nuclear power plants. A list is presented which shows the functions to be performed by the measuring equipment and the equipment and measuring methods that have been applied so far in practice are described. (GE)

35537 (TID/SNA-1168) CONTROL OF MALFUNCTIONS ON TEST AND OPERATIONAL NUCLEAR POWERED ROCKETS. Mageean, J. V. (Aerojet-General Corp., Azusa, Calif. (USA)). 29 Jun 1964. 59p. Dep. NTIS $6.00.

Analog simulation studies were conducted on basic control problems associated with malfunctions of test and operational nuclear rockets for development of control systems to improve "Fail-Safe" performance. The ability of the engine system to recover from malfunctions can be related to stability and reliability of the engine system and components. Control methods were considered, including inter-loop coupling to increase the inherent bandwidth of the engine. Study conclusions indicated that sequencing control modes would be critical in low power ranges where engine response to control commands is low. Component failures, unless compensated, would constitute gross malfunctions leading to an engine shutdown excursion. The nature of transients resulting from major component failures were studied. Results indicate that one problem area may be the development of effective emergency ground control systems used in static firing of test engines. To provide an effective emergency system for test engines, some system components should be located in close proximity to the engine, which may place them in the high radiation field. (auth)

35538 (TID/SNA-1379) NJD-11, XE-1 SAFETY EVALUATION REPORT, PHASE II. Supplement 2. (NERVA Test Operations, Jackass Flats, Nev. (USA)). [nd]. 5p. Dep. NTIS $4.00.

Calculations justifying relaxed restrictions on testing under certain meteorological conditions are presented. Test facility modifications, new safety procedures, standby emergency evacuation buses, and past experience are the basis for the changes. Also considerably more protection (water spray cooling) has been provided against exhaust plume heating of the test stand under unfavorable meteorological conditions. (LTN)

35539 (UJV-3254-R) EMERGENCY HEAT REMOVAL AND OPERATIONAL TRANSIENT PROCESSES IN FAST SODIUM-COOLED REACTORS. Pfann, J.; Dusek, J.; Macek, J. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Nov 1974. 25p. (In Czech). Dep. NTIS (US Sales Only) $4.25.

A mathematical model for the solution of transients in sodium cooled fast reactor is presented. The field of particular interest is in problems of reactor scram and emergency heat removal. The equations of heat transport are included which make possible to evaluate the variation of temperatures of important reactor and primary circuit components. Hydrodynamic of coolant flow transients is described in a separate report. The additional stresses in the pipe-wall which arise from temperature shocks can be evaluated. The model assumes a number of parallelly working cooling loops and the reactor core can be divided into a number of parallel zones. Various perturbations such as reactivity input, failure of one or more circulating pumps, the change in heat exchanger heat removal rate, or some combinations of them can be investigated with the model presented. 11 references. (auth)

35540 (WANL-TME-1126(Suppl. 1)) SUPPLEMENT 1 TO NRX/EST SAFETY EVALUATION REPORT. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 15 Nov 1965. 36p. Dep. NTIS $5.00.

35541 (WANL-TME-1126(Suppl. 2)(Rev. 1)) SUPPLEMENT 2 TO NRX/EST SAFETY EVALUATION REPORT. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 20 Nov 1965. 25p. Dep. NTIS $4.25.

35542 (WANL-TME-1126(Suppl. 3)) SUPPLEMENT 3 TO NRX/EST SAFETY EVALUATION REPORT. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 27 Dec 1965. 29p. Dep. NTIS $4.50.

35543 (WANL-TME-1126(Suppl. 3)(Rev. 2)(Add. 1)) NRX/EST SAFETY EVALUATION REPORT. Hemmerle, E. H. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 27 Jan 1966. 2p. Dep. NTIS $4.00.

35544 (WANL-TME-1126(Suppl. 4)) SUPPLEMENT 4 TO NRX/EST SAFETY EVALUATION REPORT. Skaritka, J. (Westinghouse Electric Corp., Pittsburgh, Pa (USA). Astronuclear Lab.). 15 Feb 1966. 20p. Dep. NTIS $4.00.

35545 (WCAP-8432(Vol. 1)) ECCS HEAT TRANSFER EXPERIMENTS WITH UPPER HEAD INJECTION. Volume I. Test Facility, Procedures, and Data. Cunningham, J. P.; Fayfich, R. R.; Mendler, O. J.; Steer, R. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Oct 1974. vp. Westinghouse Electric Corp., Pittsburgh.

The experimental program which has been performed by Westinghouse to develop heat transfer correlations applicable to the conditions calculated to occur in a pressurized water reactor (PWR) core following a large-break LOCA with cooling water supplied by the UHI System is described. The G-1 test facility including the data acquisition system, the rationale for the range of test parameters selected, the method of testing, the data reduction programs used and the test data obtained are presented. (auth)

35546 BURNOUT POWER IN TRANSIENT CONDITIONS. Hein, D. (Siemens A. G., Berlin (F. R. Germany)); Mayinger, F. (Technische Univ. Hannover (F. R. Germany)). pp 93-117 of Two-Phase Fluid Thermodynamics. Proceedings of a Symposium Organized by CNEN Under the Sponsorship of the Italian-Latin American Institution. Rome; CNEN (1973).

From two-phase flow day; Rome, Italy (9 Jun 1972). 35 refs.

The burnout behavior of the reactor core, during loss of flow and loss of coolant, is investigated. First the burnout behavior

of simple geometry and of rods in power and mass flow transients, in water as well as in Freon, is discussed. Subsequently a combined power and mass flow transient as can be expected in loss of flow is treated. Pressure transients in loss of coolant are also mentioned. (INIS)

35547 PROBLEMS IN NUCLEAR POWER GENERATION. Obba, Hideki (Japan Broadcasting Corporation, Tokyo). 10: No. 3, 210-214(Mar 1974). (In Japanese).

According to the long-range program by the Japanese AEC, nuclear power generation is being increased tremendously. In this situation, the problems of siting, power reactor technology, fuel supply, fuel reprocessing, waste disposal and warm water are explained, and finally doubt is thrown on the propriety of energy-consuming industry itself. Nuclear power plants in Japan use mostly light-water reactors based on foreign technology, without definite assurance in their reliable operation. Fuel reprocessing is bound to be carried out domestically, which produces large amounts of radioactive wastes. In Japan, the warm water released from the power stations with light-water reactors presents a major problem in local fisheries. The need for the rapid rise in nuclear power generation, or the structure of industries itself, may need restudy. (JA)

35548 OUTLINE OF THE LEAK-RATE TESTS FOR A REACTOR CONTAINMENT VESSEL. Hashimoto, T. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)). Haikan Gijutsu; 16: No. 10, 169-173(Aug 1974). (In Japanese).

Concerning the integrity of reactor plants, the leak-rate testing of containment vessels is carried out on the containment vessel boundary as the barrier in case of a coolant outflow accident. The purpose is to ensure the airtightness of the vessels for eliminating consequences on nearby populations. The leak-rate test currently carried out for light water reactor plants is described: the kinds of leak-rate test, the scope of Class A tests (overall test by pressurizing the whole containment vessel boundary), the requirements for plants in Class A tests, testing pressure and permissible leak-rate, measuring instruments for the test, leak-rate calculation formula according to standard vessel method, and processing of data. (JA)

35549 THE NON-NUCLEAR BLOW-DOWN TESTS FOR THE PRESSURE RELIEF SYSTEM IN THE BRUNSBUETTEL NUCLEAR POWER PLANT. P. 1. Planning and Performance of Tests. Melchior, K.; Kempf, B.; Rupp, W. (Kraftwerk Union A. G., Offenbach (F. R. Germany)). pp 511-514 of Reactor Conference, Nuernberg 8.4.-11.4.1975. Section 3: Design, Construction and Operation of Nuclear Power Plants and Their Components. Leopoldshafen, F. R. Germany; ZAED (1975). (In German)

From reactor conference; Nuernberg, F. R. Germany (8 Apr 1975). 4 figs.

Pressure suppression experiments with the corresponding nozzles have been carried out in the Brunsbuettel reactor under operating conditions for the following purposes: (1) confirmation of test and design data of the pressure suppression system, (2) measurement of pressures in the condensation chamber, (3) analysis of the dynamic behavior of the pressure suppression chamber. (GE)

35550 THE NON-NUCLEAR BLOW-DOWN TESTS FOR THE PRESSURE RELIEF SYSTEM OF THE BRUNSBUETTEL NUCLEAR POWER PLANT. P. 2. Presentation of Measured Values. Becker, M.; Hoffmann, D.; Koch, E.; Werner, K. D. (Kraftwerk Union A. G., Offenbach (F. R. Germany)). pp 515-518 of Reactor Conference, Nuernberg 8.4.-11.4.1975. Section 3: Design, Construction and Operation of Nuclear Power Plants and Their Components. Leopoldshafen, F. R. Germany; ZAED (1975). (In German)

From reactor conference; Nuernberg, F. R. Germany (8 Apr 1975). 5 figs.

Results are presented of blowdown tests conducted in the Brunsbuettel reactor under operating conditions with a new pressure suppression system. Condensation was normal within the entire operating range, and stresses and pressure loads on components corresponded to normal values. The performance of the newly developed perforated nozzle exceeded expectations. (GE)

35551 UNDERGROUND CONSTRUCTION OF NUCLEAR POWER PLANTS. Kodama, K. (Ministry of International Trade and Industry, Tokyo (Japan)). Genshiryoku Kogyo; 20: No. 8, 38-42; 54(Aug 1974). (In Japanese).

An investigation group regarding the underground location method for atomic power plants was started by the Ministry of International Trade and Industry in February 1974. The present situation and future policy of this investigation are explained. Specifically, interest is directed to the reduction of nonresidence areas and low population regions. First, several layouts for pressurized water reactors and boiling water reactors according to horizontal tunnel type are given. Next, a large practical atomic power plant of 2,000 MW consisting of 2 boiling water reactors is considered, referring to the overground systems of Tokai[-2] and Fukushima[-1] reactors. It will require two million m^3 of excavation, and the excavation expense is estimated to be 26,000 million yen. It will be added to 200,000 million yen for overground location. According to the determination of ground configuration, the mountain should be higher than 600 m above sea level, and site area should be larger than 600 m radius, including the area for excavated waste disposal, material stock yards, dormitory, etc. The future policy of investigation is directed to the detailed examination of bedrock, perfect water tightness, the size restriction of equipments, period of construction and utilization of wastes. (JA)

35552 REPORT OF THE SUB-SECTIONAL MEETING ON HEATED-WATER DISCHARGE, SPECIALIST MEETING ON ENVIRONMENT AND SAFETY. Genshiryoku linkai Geppo; 18: No. 12, 28-35(Dec 1973). (In Japanese).

In Japan, all nuclear power plants are sited facing the sea. Cooling water for turbine condensers is taken from the sea and heated water is returned to the sea, thereby a problem is caused in the local fishery. The results of studies made by the subsectional meeting are described: the problem of heated-water discharge; the surveys made on the problem, including heated-water diffusion and the consequences on environment; and the measures to be taken for the problem including future research subjects, methods to mitigate it, heated-water utilization, and the evaluation of power generation sites. (JA)

35553 RESPONSE OF NUCLEAR STRUCTURAL SYSTEMS TO TRANSIENT AND RANDOM EXCITATIONS, USING BOTH DETERMINISTIC AND PROBABILISTIC METHODS. Hitchings, D. (Imperial Coll. of Science and Technology, London (UK)); Dance, S. H. (Babcock and Wilcox Ltd., London (UK)). Nucl. Eng. Des.; 29: No. 3, 311-337(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The finite element method is commonly used for the static analysis of reactor components and the same ideas can be applied to the dynamic analysis. The formation of various damping matrices for both internal and external damping is discussed. For the most part only the linearized form of the equations of motion is considered. The type of solution adopted depends upon both the force input and the required response. For a short period transient input, usually only the initial response, is required which is best found from a step-by-step integration. A method involving a Taylor series of steps is developed and applied to the solution of a beam subject to a pressure transient. For a periodic force input the steady state response is needed requiring the determination of the damped eigenvectors. An efficient algorithm, using the undamped vectors, is given and the response to an arbitrary force input developed. This method is applied to the previous example and the two solutions are compared illustrating the advantages and disadvantages of each method. As an example the spectral density of the response due to random imposed movements is given illustrated by a series of heat exchange tubes excited by random forces. The response due to a nonstationary force input such as an earthquake is discussed. The step-by-step method of analysis is used to predict the probability density function of the response of a simple system at any time under such a nonstationary input. Possible modes of failure with reference to reactor components are discussed and indications of how the preceding theory can be applied to predicting failures are given. (auth)

35554 BASIC PROBABILISTIC CONSIDERATIONS ON SAFETY OF PRESTRESSED CONCRETE PRESSURE VESSELS. Shinozuka, M. (Columbia Univ., New York (USA)); Shao, L. C. (USAEC Directorate of Licensing, Washington, D. C.). Nucl. Eng. Des.; 29: No. 3, 338-345(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The purpose of the present study is to lay the foundation for the probabilistic safety analysis pertinent to prestressed concrete pressure vessels of nuclear generating stations. A major emphasis is placed on the consistency with which various aspects of structural and statistical significance are analyzed and then combined into a probabilistic formulation amenable to practical risk assessment and assurance. In particular (1) prestressed concrete pressure vessels subjected to loads of various temporal nature are considered, (2) the probabilistic algebra used in risk assessment is basically that of the second moment–first order approximation, and (3) the method thus established is applied to reliability analysis of prestressed concrete reactor vessels (PCRVs) to

estimate the probability level of ultimate failure. The result of the present study indicating the probability level of the vessel reliability depends entirely on the assumptions concerning statistical aspects of loading conditions and resisting capacities of the vessel and on the approximations in relation to stress and structural analysis and ultimate failure conditions. Therefore, the resulting probability values are illustrative and comparative rather than factual at this time. (auth)

35555 PROBABILISTIC ASSESSMENT OF SEISMIC RISK FOR NUCLEAR POWER PLANTS. Chelapati, C. V. (Department of Civil Engineering, California State University, Long Beach, California 90840, USA); Wall, I. B. (General Electric Co., San Jose, Calif. (USA). Atomic Power Equipment Dept.). Nucl. Eng. Des.; 29: No. 3, 346-359(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

Probabilistic approaches to the design, siting, and safety analysis of nuclear power plants have been proposed by Farmer, Wall, and Garrick. Farmer and Wall established a limit line which delineates between acceptable and unacceptable risks. To implement the method, all accidental chains are systematically analyzed to determine their probability and associated fission product release magnitude; the combination is compared to the limit line. For proper implementation, the seismic risk should be evaluated in a quantified manner. Conceptually, this evaluation is made in two stages: the probability of an earthquake occurrence as a function of its intensity and, given a seismic intensity, the conditional probability of damage. This paper reports on an initial study into the latter aspect. (auth)

35556 PRINCIPLES OF RELIABILITY ANALYSIS METHODS APPLIED TO AN EMERGENCY CORE COOLING SYSTEMS. Balfanz, H. P.; Heuser, F. W.; Ullrich, W. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). Nucl. Eng. Des.; 29: No. 3, 384-394(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

A reliability analysis is given for a model system of an emergency core cooling system of a pressurized water reactor. In order to demonstrate some basic relationships and influences on the system's failure probability, the analysis deals only with some of the main-components and subsystems of the emergency core cooling system. With reference to the design basis accident, i.e., the total rupture of a main coolant line, only the low pressure system is considered. The overall system's failure probability is determined by the failure probability per demand, i.e., the unavailability of the system when called on for operation in the emergency case, and the cumulative probability of failure during the subsequent phase of residual heat removal. Detailed calculations have shown that the failure probability per demand is the leading term. Special attention is given to some parameter calculations dealing with the influence of inspection time intervals and repair procedures for different components and subsystems with respect to system failure behavior. (auth)

35557 NUCLEAR POWER PLANTS ON SEA AND WASTE HEAT PROBLEMS. Keller, C. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Radiochemie). Naturwiss. Rundsch.; 27: No. 8, 313-314(Aug 1974). (In German).

The author regards the main reason for the trend to erect nuclear power plants on the sea as being the problem of the removal of waste heat. Within the framework of water cooling, he discusses the fresh-water cooling on rivers and the operation of wet and dry-type cooling towers. (GE)

35558 POINT OF VIEW ON THE ASEISMATIC DESIGN OF PIPING SYSTEM FOR NUCLEAR POWER PLANTS. Ichiki, T.; Fukasawa, M.; Matsumoto, T. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Haikan Gijutsu; 16: No. 8, 155-162(Jul 1974). (In Japanese).

A method of analysis for aseismic design is described. Systems in a nuclear power plant are classified according to the seriousness of the effects of their being damaged. The most important systems are classified As. Systems which are necessary for protection of the public at the time of accident are grouped as A class. Systems classified as B class are less important, but are related to radioactivity. Systems of C class are those other than As, A, and B classes. Another important factor is the natural frequency of piping system. The analysis of vibration is made by using a model. One of the models is the continuous beam model, and another is the multiple mass model. The analysis of response to earthquake is made after the vibration analysis. For practical aseismic design, the design is performed according to the importance classification, pipe diameter, and service temperature of the system. The remaining points are then taken into consideration. Those are branches, connecting parts of pipes and equipment, piping between two buildings, parts with attached valves, underground pipes which pass through buildings, and outdoor piping. Problems to be taken into consideration for making models are described, and a model experiment is explained. (JA)

35559 PHILOSOPHY OF NUCLEAR SAFETY IN JAPAN. Uchida, H. (Tokyo Univ. (Japan)). At. Jap.; 18: No. 5, suppl.1, 4-9(May 1974).

Lectures and panel discussions on light water reactor safety problems are described. Japan must consider the effect of radioactive effluents on the public. Light-water type nuclear power plants must be designed, operated, and controlled in accordance with regulations so as to reduce to 5 mrem/yr the exposure dose from radioactive gaseous substances for any off-site individual. According to Japan AEC, reactor siting criteria postulate two kinds of accidents. One is a major accident used for the assessment of necessary zoning for non-residential areas. The other is a hypothetical accident used for assessing the zone of low population density. Safety countermeasures in addition to those against loss of coolant accident (LOCA) have been studied in Japan for years and have been checked against the siting criteria covering the postulated accidents such as steam pipe rupture of boiling water reactors, steam generator tube rupture of pressurized water reactors, and major rupture of radioactive gas storage tanks. Many opinions advanced by many people on design-basis accidents are summarized. The frequency of the design-basis accidents should not be more than 10^{-6} per reactor year to ensure nuclear safety. A question that the postulated major accidents should be considered as the design-basis accidents, and another question that the common mode failure of major components, meltdown, and even the possibility of being hit by an aircraft should be taken into account are discussed. (JA)

Reactor Theory and Calculation

Refer also to abstracts 32485, 34777, 34779, 34847, 34904, 35204, and 35206.

35560 (IKE-4-20) COMPARISON OF NUMERICAL METHODS FOR SOLVING BURNUP EQUATIONS. Neubauer, W.; Wohland, H. (Stuttgart Univ. (TH) (F.R. Germany). Inst. fuer Kernenergetik). Mar 1974. 37p. (In German). INIS.

5 figs.; 5 refs. With app. Available from ZAED.

One of the essential parts of program systems for burnup calculations is a module permitting calculation of the time-dependent change of isotope densities. A comparative evaluation of two standard procedures, the RKSG (Runge–Kutta) method and the HPCG method (predictor-corrector method) is presented. Two special methods, the IKEV method (transformation and subsequent iteration) and the method ANALYT (analytical solution), are also compared. (GE)

35561 (JAERI-M-5832) CORRECTION OF THE ABSOLUTE REACTOR POWER MEASURED BY REACTOR NOISE ANALYSIS. Terada, H.; Takeda, K.; Nakata, H. (Japan Atomic Energy Research Inst., Tokyo). Sep 1974. 21p. (In Japanese). INIS.

The absolute value of reactor power, P_n, obtained by reactor noise analysis, which is used routinely in the JMTRC has been compared with values obtained by the neutron flux integration method, P_f and thermohydraulic measurements, P_t. The results are $P_f/P_n = 1.16 \pm 0.02$ and $P_t/P_n = 1.14 \pm 0.10$. The values are approximately in agreement with the geometrical factor calculated for the core of the JMTR. The reactor power by reactor noise analysis is thus multiplied by this coefficient to give the most probable value of reactor power. (auth)

35562 (KFK-2074) MONTE CARLO CALCULATION OF RATIOS IN REACTOR PHYSICS. Brandl, V. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Feb 1975. 59p. (In German). Dep. NTIS (US Sales Only) $6.00.

A solid theoretical basis of the Monte Carlo calculation of ratios is established. The exact distribution density of ratios is developed and discussed. In addition for the Monte Carlo Practice a handy approximation formula of the distribution density and the statistical error of quotients is developed. Its quality and validity range are discussed in a parameter study. (4 references) (auth)

35563 (WANL-TME-264) CRSAVE. Ortenberg, L. I. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 4 Dec 1962. 20p. Dep. NTIS $4.00.

In order to fully realize the advantages gained through the use of multithermal group methods, the final stage of the standard design model (CURE) requires a conversion of the multithermal macroscopic cross sections to a single, appropriately weighted,

thermal cross section. CRSAVE, a Fortran program for the IBM 7094 computer, performs this conversion. (auth)

35564 (WANL-TME-1933) TESTS OF THE GGC-3, GGC-4 NEUTRON SLOWING DOWN CODES AND COMPARISONS WITH THE CODES GAMBIT AND TRANSFER. Gibson, G.; Moran, L. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1969. 42p. Dep. NTIS $5.25.

The Gulf General Atomic computer programs GGC-3 and GGC-4 which provide multigroup cross sections have been obtained from the Argonne Code Center, and have been made operational on the CDC-6600 computer. The purpose of this report is to draw attention to the fact that these programs are available at WANL, to point out some of the differences with existing codes at WANL, and to present the results of some calculations carried out with the codes. Comparisons are made of these results with those obtained by solving the identical problems with the GAMBIT and the Oak Ridge National Laboratory TRANSFER computer programs. Such comparisons serve a useful purpose, viz., as checks on the methods of computation, times required for the computations, cross section libraries, etc. (14 references) (auth)

35565 (WANL-TME-2781) USER'S MANUAL FOR DODAPR (DOT DATA PROCESSING CODE FOR REACTOR ANALYSIS). Kyslinger, J. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 11 Mar 1971. 38p. Dep. NTIS $5.00.

DODAPR is a FORTRAN IV computer program which is operational on the CDC-6600 computer. DODAPR accepts the neutron fluxes from the scalar flux tape generated by a previous DOT transport calculation. The code calculates integrated, volume-averaged heating rates for arbitrary volume elements (nodes) and provides a punched output of the heating rates and thermal node numbers in a format compatible with the input required for the thermal analysis program TAP-A. (auth)

35566 (WANL-TME-2782) USER'S MANUAL FOR PERT-2D (PERTURBATION THEORY, TWO-DIMENSIONAL). Kyslinger, J. A.; Ravets, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 11 Mar 1971. 26p. Dep. NTIS $4.50.

PERT-2D is a two-dimensional perturbation theory computer program written in FORTRAN IV and operational on the CDC-6600. The code uses the first-order approximation in solving the transport theory perturbation equations and applies the transport corrected isotropic scattering approximation to the in-group scattering terms. PERT-2D accepts the forward and adjoint angular fluxes as calculated by the DOT discrete ordinates transport code. PERT-2D calculates reactivity changes due to small perturbations in the region dependent cross sections of a specified material. (auth)

35567 (WANL-TMI-687) MODIFICATION OF RESONANCE CALCULATION IN GAM-I PROGRAM, AND INSTRUCTIONS FOR GDTM PROGRAM. Stevens, C. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 14 Jun 1963. 17p. Dep. NTIS $4.00.

35568 (WANL-TMI-713) DOODLES, A FORTRAN PROGRAM FOR COMPUTING ELASTIC TRANSFER MATRICES FOR GAM-I PROGRAM. Long, G. A.; Stevens, C. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 25 Jun 1963. 7p. Dep. NTIS $4.00.

A computer program has been written to calculate elastic transfer coefficients for the GAM-I program. The details of the computations performed by DOODLES, as well as instructions for its use are given. (auth)

35569 (WANL-TMI-758) GENERAL STUDY OF TEMPERATURE EFFECTS IN BERYLLIUM REFLECTED GRAPHITE REACTORS. Kopp, L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 29 Jul 1963. 32p. Dep. NTIS $4.75.

A general study of cold to hot reactivity changes for highly-enriched uranium graphite-moderated spheres reflected by six inches of beryllium over a C/U range of 50 to 2000 is presented using the standard design method with and without the Doppler effect. 5 references. (auth)

35570 (WANL-TMI-856) MEASUREMENT OF THE DOLLAR SHUTDOWN REACTIVITY IN HIGHLY SUBCRITICAL CONFIGURATIONS. Riese, J. W. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 7 Nov 1963. 13p. Dep. NTIS $4.00.

Some proposed schemes for measuring the dollar shutdown reactivity in a highly subcritical assembly are discussed from the viewpoint of theoretical validity. It is concluded that the method of Garelis and Russel (Nuclear Sci. and Eng. 16, 263-270(1963)) for analyzing pulsed neutron measurements is the best presently available. Some simpler approximations to their analysis are also presented and evaluated, including a criterion for best positioning of source and detector. (auth)

35571 (WANL-TMI-902) COMMENTS ON WANL-TMI-856, MEASUREMENT OF THE DOLLAR SHUTDOWN REACTIVITY IN HIGHLY SUBCRITICAL CONFIGURATIONS. Rothman, A. B. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 18 Dec 1963. 7p. Dep. NTIS $4.00.

Use of an oscillating source, according to the method in WANL-TMI-856, for the measurement of the dollar shutdown reactivity of a highly subcritical assembly is reviewed. The treatment is extended from a sinusoidal source input to include other ways shapes with a periodic frequency. The effects of long range delayed photoneutron transients, such as for cores reflected by beryllium suggest itself as a possible source of error. (auth)

35572 (WANL-TMI-1121) DEFINITION OF REACTIVITY. Ravets, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 9 Jun 1964. 9p. Dep. NTIS $4.00.

The proper relation to use when determining the reactivity difference between numerical calculations is presented. (JWR)

35573 (WANL-TMI-1426) TWO-DIMENSIONAL DIFFUSION THEORY CODE, EXTERMINATOR. Kopp, L. I. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 23 Mar 1965. 6p. Dep. NTIS $4.00.

EXTERMINATOR, a multigroup, two-dimensional reactor diffusion code, written by Oak Ridge in FORTRAN, allowing XY, RZ, or RO geometry has been made operational at WANL. This code allows use of zero flux, symmetry, or periodic outer boundary conditions as well as the internal rod boundary condition. Eigenvalue problems, constant source problems, or poison search problems may be solved and input cross sections may be macroscopic, microscopic, or both. Most important of all, the code allows scattering from any group to any other group. This feature allows cross sections to be used directly from GAM-THS without the necessity of collapsing the full scattering matrix to one containing only down-scatter to the next energy group as is presently required for multithermal group calculations with CURE, the present NSDM-I (r,O) calculation tool. (auth)

35574 (WANL-TMI-1652) PFINC: A FORTRAN-II PROGRAM FOR PREPARING PFENCE INPUT TAPES. DeBaryshe, P. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Mar 1966. 14p. Dep. NTIS $4.00.

PFINC is an acronym for PFENCE INput Code. The PFINC program prepares input tapes for R-θ PFENCE problems. The PFINC program accepts input fluxes at physical mesh points of a reactor, edits them and prepares a tape identical to the output tape which would be prepared by the EXTERMINATOR code for the same physical problem. In addition, the edited fluxes are also printed in EXTERMINATOR format by a modified EXTERMINATOR output routine. (auth)

35575 (WANL-TNR-045) SINGLE CHANNEL ANALYSIS PROGRAM (SCAP) FOR THE TEMPERATURE DISTRIBUTION IN AN INTERNALLY-COOLED HEAT GENERATING SOLID COOLED BY A COMPRESSIBLE GAS. Pierce, B. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1962. 35p. Dep. NTIS $4.75.

A FORTRAN coded Single Channel Analysis Program (SCAP) that has been developed to calculate temperature distributions in a heat generating solid is described. Equations were derived representing heat transfer and pressure drop for gas flowing in a passage of a heater. The program is completely general to facilitate the examination of various parameters, such as film heat transfer correlations, materials, system configurations, and gases. (6 references) (auth)

35576 (WANL-TR-6535) TRIP TO OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, TENNESSEE. Disney, R. K.; Carditio, J. M. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 12 Oct 1970. 10p. Dep. NTIS $4.00.

The ORNL-RSIC-MAGI Monte Carlo Seminar-Workshop was sub-divided into two parts. The first portion consisted of a seminar of papers by participants on the development and application of Monte Carlo techniques at their respective installations. Attachment 2 is the agenda of this meeting. The second portion consisted of a workshop on the Adjoint Monte Carlo Code, ANTE-2, and a workshop on the Multi-group Monte Carlo code, MORSE. (auth)

35577 CAVITY EFFECT ON NEUTRON SPECTRA. Kudo, K.; Narita, M.; Ozawa, Y. (Hokkaido Univ., Sapporo (Japan). Faculty of Engineering). pp 238-242 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor

Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese)

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

The cavity effect on neutron spectra was investigated by time dependent Sn method in fast neutron multiplication system and non-multiplication system containing cavity. Analysis was made on the spherical systems of ^{235}U for the multiplication system and $(CH_2)_n$ for the non-multiplication system which contain a cavity with variable radius at the center. The nuclear constant used was ABN 26 group set. Decay curves in the ^{235}U spherical assembly were obtained. (JA)

35578 CODE SYSTEM FOR THE CALCULATION OF RADIATION HEAT GENERATION. Miyasaka, S.; Taji, Y.; Inoue, S.; Ideta, T.; Asaoka, T. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). pp 190-199 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese).

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

The code system for the calculation of radiation heat generation can estimate the distribution of heat generation inside and outside the core of nuclear reactors and can calculate systematically (1) neutron transfer, (2) neutron heat generation, (3) secondary gamma ray source, (4) gamma ray transfer, (5) gamma heat generation, and (6) various group cross sections. The experimental results of V-3-B1 and V-3-B4 systems of Fast Critical Assembly were analyzed by applying the code system, and the accuracy of this code system was evaluated. (JA)

35579 ANALYSIS OF FAST PULSED NEUTRONS BY THE SUPERPOSITION OF WAVE MODES. Hino, T.; Narita, M.; Ozawa, Y. (Hokkaido Univ., Sapporo (Japan). Faculty of Engineering). pp 120-129 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese)

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

Analysis of fast pulsed neutrons was performed with the Neumann series solution of energy-time dependent neutron transport equation. The Fourier-Laplace transformation of neutron flux was obtained from a reduced three dimensional transport equation, then it was expanded to binomial series, and inverse Laplace and inverse Fourier transformation were made by using folding theorem. The neutron flux was expressed by the Green function of energy dependent neutron flow. Analysis was performed by using continuous energy model and multi-group model. The results with the multigroup model were used for the calculation of time-energy distribution in an iron assembly. The number of energy groups was 16. The analysis was extended to a limited system $-a \leq Z \leq a$. The mirror image principle used by Gotoh was applied. The present method of analysis is good for a system having no standard mode and can be applied to an anisotropic time dependent transport equation. (JA)

35580 BILINEAR AVERAGING METHOD IN NUCLEAR CONSTANT SPACE. Komata, M. (Hitachi Ltd., Kawasaki, Kanagawa (Japan). Atomic Energy Research Lab.). pp 77-86 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese)

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

In the calculation of eigenvalues in multiregion systems, usually cell calculation (first step) and the eigenvalue calculation of macroscopic system (second step) are performed. In the first step, it is assumed that the cell calculation for the real system can be substituted by the cell calculation for infinite system. This assumption is only an approximation. This assumption leads to the aberration of neutron flux in a cell from the correct one. Therefore the eigenvalue of the system can not be correctly evaluated. In this new method, the system which is usually treated in the second step is regarded as the perturbation system of the real system. This method does not separate the system into two steps, but treats the system unificatively. This is the most effective evaluation method for cross section from the viewpoint that the error of eigenvalues must be made a minimum. This calculation takes a form of a bilinear averaging method. But this method does not strictly agree with the bilinear averaging method of Nicholson. The relation among the bilinear averaging method of Nicholson, this new method, and usual linear averaging method is clarified. (JA)

35581 TIME DEPENDENT CHARACTERISTICS OF THE CAPTURE CROSS SECTION OF FISSION PRODUCTS IN A FAST NEUTRON REACTOR. Ohtake, I. (Fuji Electric Co. Ltd., Tokyo (Japan)). pp 102-105 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese)

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

About 300 kinds of nuclides are produced by fission during the burnup of nuclear fuel in fast neutron reactors. As for an in-core neutron spectrum for calculating the effective capture cross section of fission products, that of a prototype 2500 1 PuO_2-UO_2 reactor core was employed. In order to study the existing quantity of fission products during each burnup time, beta decay chains were pursued. In this calculation, FP-1 code was employed. With regard to the yield of fission products, Pu-239 fast yield data by Meek and Rider was utilized. The important fission product nuclides in a fast neutron reactor were determined by multiplying the effective capture cross section by the existing quantity of fission products. (JA)

35582 ANALYSIS OF HETEROGENEOUS EFFECT OF PLATE CELL. Kikuchi, Y.; Katsuragi, S.; Takano, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). pp 60-67 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese)

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

Up to now, some simple and efficient analytical methods for fast breeder reactors have been developed. For example, in Japan, the concept of JAERI-FAST Set was established, and the set of group constants was made up. But in the JAERI-FAST Set and the relevant analytical codes, the following three problems are left: (1) the accuracy of employed nuclear data, (2) treatment of heterogeneous effect, and (3) treatment of resonance scattering effect. In this study, the treatment of heterogeneous effect was investgated. EXPANDA-5 was previously developed as a simple and efficient calculation code to treat the heterogeneous effect of two region hexagonal lattice system. For applying this code to a plate cell system, EXPANDA-5 was improved into EXPANDA-75. The EXPANDA-75 executes one dimensional diffusion calculation after evaluation of the effective macroscopic cross section of the plate cell. (JA)

35583 DEVELOPMENT OF CALCULATION PROGRAMS AND REACTOR CONSTANTS FOR FAST NEUTRON REACTORS. Katsuragi, S. (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Tokai Research Establishment). pp 51-59 of Fast Reactor Physics. Proceedings of AESJ 1973 Topical Meeting on Fast Reactor Physics. Tokyo, Japan; Atomic Energy Society of Japan (1973). (In Japanese)

From 1st topical meeting on fast reactor physics; Tokai, Ibaraki, Japan (11 Jun 1973).

The treatment of resonance cross section and effective cross section in fast neutron reactors is more important and more difficult than in thermal reactors. As usual semi-analytical methods are insufficient, a new method was developed, in which the cross section and neutron spectra are directly calculated by generating resonance parameters with a stochastical method. In JAERI-FAST Set, the resonance parameters were generated by paying attention to that the cross section with low resolving power agrees with experimental data. As to the treatment of effective cross section, the treatment of the resonance scattering of light nuclides and the calculation of the effective resonance cross section of heavy nuclides are important. For this processing, PROF GROUCH-G code was developed. In order to derive the effective resonance cross section of heavy nuclides, hyperfine spectrum calculation code was developed. As for two dimensional diffusion calculation codes, in 1971, HEXA was developed for hexagonal lattice system, and TRI-2D was developed for two dimensional triangular lattice system. In 1972, HEXA-Z was developed for three dimensional hexagonal lattice system. (JA)

35584 NUMERICAL SOLUTIONS OF DISCRETE-ORDINATE NEUTRON TRANSPORT EQUATIONS EQUIVALENT TO P_1 APPROXIMATION IN x-y GEOMETRY. Jung, J.; Ohtani, N.; Kobayashi, K.; Nishihara, H. (Kyoto Univ. (Japan). Faculty of Engineering). J. Nucl. Sci. Technol. (Tokyo); 11: No. 6, 231-241 (Jun 1974).

A numerical method for solving the steady-state one-velocity neutron transport equation in x-y geometry is presented. It is based on the concept of combining the spherical harmonics theory with the discrete-ordinate method. The validity of the method is illustrated by several numerical computations using the TWOTRAN-PLXY code, formulated by modifying the ordinary discrete-

ordinate code TWOTRAN-(x,y). Through numerical studies, it is shown that the present method is effective for obtaining solutions of high accuracy, as well as for eliminating the ray effects present in the ordinary discrete-ordinate method. As for the techniques for accelerating the convergence of the iterative solutions, it is proved that the Chebyshev device works well for the present method, while whole-system rebalancing is found to be less effective. (auth)

35585 ANALIZA NUMERICA PENTRU REACTORI NUCLEARI. (Numerical Analysis for Nuclear Reactors). Pavelescu, M. (Institutul de Fizica Atomica, Bucharest (Romania)). Bucharest, Romania; Editura Academiei RSR (1974). 351p. (In Romanian).

The principal concepts of numerical analysis, meant to allow the evaluation of critical states of nuclear reactors in general, and of fast reactors in particular are treated within the framework of diffusion approximation. Methods are discussed which appear in reactor physics in mono or two-group-diffusion approximations, when analytical methods of solving are used. The second chapter is destined to matrix analysis. The following chapter is devoted to a very important field of matrix analysis, namely nonnegative matrices. With this opportunity, irreducible and reducible non-negative matrices are introduced, and a rigorous and modern demonstration of the Greshgarin and Perron-Frobemins theorems are given. In chapter 4, the direct methods for solving nonhomogeneous linear equations is treated. Chapter 5 refers to finite difference equations. The analytical solutions of finite difference equations are discussed. In chapter 6, the numerical solutions of differential equations are examined. The methods described lead to the so-called open solutions and the ideas are used to solution of the partial elliptic equations. In chapter 7, stationary iterative methods for solving the linear equation systems are presented. The last chapter treats the numerical solutions of elliptic partial equations of second order, which appear in two-dimensional multigroup diffusion approximation. The numerical solution of partial elliptic equations of second order which appear in multigroup diffusion approximation in two-dimensional geometries are discussed. It is shown that a particular block successive time over-relaxation method may be used. (auth)

35586 COMPARISON OF THE K_∞ VALUE OBTAINED BY THE METHOD OF ALTERNATE LATTICE AND THE THEORETICAL VALUE FOR SMALL REACTOR SYSTEMS. Matejka, K. (Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia). Fakulta Jaderna a Fysikalne Inzenyrska). Acta Polytech. (Prague), IV; No. 3, 91-96(1973). (In Czech).

From scientific conference of the Czech Technical University; Prague, Czechoslovakia (12 Jun 1973).

The application of the method of alternate lattices in determining the multiplication factor k_∞ in the exponential assembly ŠR-OB core is described. In addition to basic information on experimental and theoretical preparation, other aspects are described, such as the evaluation and application of the method. Recent results obtained by the four-group diffusion approximation are also presented. (auth)

35587 SIMULATION STUDY OF SYSTEM FOR DIAGNOSIS OF NUCLEAR REACTOR OPERATION. Ina, S.; Yoshikawa, H.; Wakabayashi, J. (Kyoto Univ., Uji (Japan). Inst. of Atomic Energy). J. Nucl. Sci. Technol. (Tokyo); 11: No. 7, 275-283(Jul 1974)

A system for diagnosing the state of operation of nuclear reactors is described. The system comprises the block TWODIS, EST and MEMORY. The signals received from a number of detectors in the reactor are led sequentially into the block TWODIS. The input signals are analyzed statistically, to identify the actual state of operation with one of several reference modes prescribed beforehand. The algorithm used here for the identifying operation is based on the linear discriminant function. When TWODIS identifies the state of the reactor with one of the abnormal reference modes, the disturbance estimating block EST set to work. This block statistically analyzes the signals depicting past history retrieved from MEMORY, and estimates the quantitative characteristics of the abnormality source (disturbance). Laguerre function expansion and multiple regression analyses are used in EST. As a numerical example, a single channel model sodium coolant fast reactor is represented by a reactor simulator, in which only the coolant outlet temperature and the coolant flow rate are chosen as state variables to be detected. The reference modes of reactor operating state prescribed for the identifying operation by TWODIS are: (1) normal state, (2) increasing power density, and (3) decreasing flow rate. The EST estimates the magnitude and time constant of the causative disturbance. Trial experiments made with simulated distrubances prove the practicality of the proposed diagnostic system. (auth)

Reactor Components and Accessories

Refer also to abstracts 32629, 32967, 33293, 33778, 33816, 33819, 33833, 33879, 33880, and 35554.

35588 (CEA-CONF-2848) APPLICATION OF STRESS WAVE EMISSION DETECTION TO THE FRENCH NUCLEAR REACTORS. Tomachevsky, E. G. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). 1974. 37p. (In French). INIS.

From French working group on stress wave emission; Senlis, France (19 Jun 1974).

The test program on stress wave emission detection for application to nuclear reactors naturally includes the characterization of materials and tests on simple and complex structures. The wide range of tests performed has shown the value of this new method of inspection and the need to take precautions in order to avoid errors and false interpretations. Emphasis is laid on these difficulties and on the results obtained. (FR)

35589 (SAND-75-0111) NUMERICAL MODELING OF CONTAINMENT WALL IMPACT BY TORNADO GENERATED MISSILES. Preliminary Results. Tillerson, J. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1975. Contract AT(29-1)-789. 30p. Dep. NTIS $4.50.

Preliminary calculations have been made to predict the response of a concrete wall to impact loading of a "typical" missile generated by tornadic winds. The numerical work was performed using the two-dimensional, Lagrangian wave propagation computer code (TOODY). The concrete was modeled as a distended material while the wooden missile was considered to be a hydrodynamic body in initial runs and an elastic body in subsequent calculations. The similarities and differences between these representations are noted and the observation is made that more precise numerical modeling is possible only if the impacting materials are accurately characterized. (25 references) (auth)

35590 (WANL-TMI-1992) APPLICATIONS OF NORMAL FUNCTION ALGEBRA WITH COMPATIBILITY COMPARISONS BETWEEN ANALYTIC AND NUMERICAL ANALYSIS. Smith, R. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1970. 29p. Dep. NTIS $4.50.

The Structural Analysis Group is evaluating two alternate approaches to the statistical treatment of all the random variables in governing stress equations. One approach is the Monte Carlo method. This method calculates a probability stress distribution by making a large number of stress calculations where each time the calculation is repeated the values for the variables in the equations are chosen randomly from their respective probabilistic distributions. An extension of the NORF Code for Estimating Reliability of Components is also presented. This approach assumes that the probability distributions are normal or Gaussian. With this assumption, the algebra of normal functions is applied directly to the stress governing equations. A normal stress distribution is calculated and compared with the assumed normal strength distribution to calculate reliability. (auth)

35591 AUTOMATIC MEASUREMENT DEVICE OF SPACES BETWEEN FUEL ELEMENTS IN REACTOR. Ishida, R.; Hasegawa, I. (to Sumitomo Electric Industries Ltd., Osaka (Japan)). Japanese Patent Document 1973-21571/B/. 16 Oct 1968. 5p. (In Japanese).

This invention relates to an automatic continuous measuring device of the spaces formed by the fuel elements throughout their entire length. A fuel element moving frame allows a fuel element reserving plate and a fuel element ascending plate to move slowly along the inclined surface. Stoppers in the array are designed to stop the fuel movement intermittently. Interlocking with the stopping of the fuel element moving frame, a pressure cylinder is actuated to start a measurement rod working. Thus the same operation may be done repeatedly. The varied spaces between the fuel elements may be made to correspond correctly to the position of the measurement rod. The intermittent automatic stopping of the fuel element moving plate allows the measurement rod to enter the spaces between the fuel plates, further decreasing the depth of the measurement rod. The present apparatus is capable of measuring the narrow and deep spaces and obtaining more accurate values by increasing the area of measurement. The automatic operation gives notice of danger due to Racking errors. It allows the measured values to be recorded and a data processing unit to be provided with a memory, thus automatically accomplishing the statistical processing of the spaces formed by the fuel elements, and furthermore providing the fundamental data on reactor operation or fuel element management. (JA)

35592 TRANSIENT PHENOMENA OF CIRCULATING WATER SYSTEM FOR THERMAL AND NUCLEAR POWER PLANTS. Kohara, I.; Ogawa, Y. (Mitsubishi Heavy Industries Ltd., Takasago (Japan). Takasago Works); Iwakiri, T.; Shiraishi, T. Tech. Rev., Mitsubishi Heavy Ind.; 10: No. 3, 191-202(Oct 1973).

An outline is described on practical analysis of transient phenomena in circulating water systems, comparison with measured values, estimation of pressure drop and measures to prevent water column separation. The theoretical calculation coincides well with actual measurements in such a complicated pumping system as a circulating water system and the water-hammer charts are also a practical means to investigate simply any possibility of water column separation. It is recommended to check first with waterhammer charts when a thermal or nuclear power plant is to be planned and to analyze the problem in detail with a computer to investigate sufficiently if something is to be further examined. (auth)

35593 GENERAL FEATURES OF 784 MW NUCLEAR TURBINE. Kawakami, H. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Kanagawa (Japan)). Karyoku Hatsuden; 25: No. 4, 356-364(Apr 1974). (In Japanese).

Nuclear power generation tends to be increasingly of large capacity, and steam conditions are low, so nuclear turbines must deal with a large amount of low-quality steam. The 784 MW nuclear turbine for the Fukushima nuclear power station, manufactured by Tokyo Shibaura Electric Co., is compared with a turbine of similar output for a thermoelectric power station. The nuclear turbine is of tandem compound type, consisting of one high-pressure turbine and three lowpressure turbines; a bypass valve is used to deal with load change. The following matters are described: outline of the turbine; features of design and construction such as drain elimination and erosion countermeasures, consideration to radioactivity, and larger capacity; and considerations taken in the improvement of operational reliability. (JA)

35594 BOLTING OF THE COVER OF A REACTOR PRESSURE VESSEL. Hamada, K.; Nakagawa, Y. (Hitachi Ltd., Ibaraki (Japan). Hitachi Works). Haikan Gijutsu; 16: No. 4, 113-119 (Apr 1974). (In Japanese).

In most nuclear reactors, the upper end plate, lower end plate, and the cylindrical part of a reactor pressure vessel are connected with flanges and bolts, so that many problems arise in the tightening of large-size bolts. The tightening of large-size bolts has been usually performed with a wrench or with a bolt heater. The wrench requires large tightening power, and the bolt heater needs long times for heating and cooling, and shows poor uniform distribution of tightening force. These two bolting devices are not used for a large-scale reactor pressure vessel. This situation prompted development fast and reliable bolting equipment. A stud tensioner is employed for many reactor pressure vessels. This study tensioner is designed to stretch bolts with oil pressure, and has many working characteristics such as (1) fast tightening, (2) high accuracy of tightening stress, and (3) no twisting of bolts. The tightening of stud bolts is performed with four stud tensioners on four stud bolts at the same time and with tightening sequence of bolts determined in advance to obtain uniform tightening stress. (JA)

35595 NUCLEAR POWER PLANTS IN INDIA. Hrusa, J. Elektrotech. Obz.; 63: No. 6, 376-378(Jun 1974). (In Czech).

The development is described of existing nuclear power plants in India according to individual reactor types. Information is given on a projected nuclear power plant. (INIS)

35596 IN-SERVICE INSPECTION AND AN ULTRASONIC TESTING TECHNIQUE FOR REACTOR PRESSURE VESSEL. Fujimoto, H.; Ito, H. (Hitachi Ltd., Ibaraki (Japan). Hitachi Works); Kanda, K.; Sasaki, S. Hitachi Hyoron; 56: No. 8, 719-724(Aug 1974). (In Japanese).

Requirements for the in-service inspection of reactor pressure vessels and design considerations for reactor pressure vessels and their surroundings in the interest of their in-service inspection are described. Also, applicability of the automatic remote controlled ultrasonic inspection technique using a compound scanning system is discussed. (auth)

35597 INDUSTRIAL APPLICATION OF FRACTURE MECHANICS. Radaj, D. (Daimler-Benz A. G., Stuttgart (F. R. Germany). Hauptabteilung Entwicklung und Zentrale Berechnung). Z. Werkstofftech.; 5: No. 8, 440-447(Dec 1974). (In German).

14 figs.; 33 refs.

Application of fracture mechanics in the design of reactor pressure vessels, welded joints, and piping systems is illustrated. One object of fracture mechanics is to provide information on safe operating limits. The concepts of crack initiation and crack arrest are discussed. (GE)

35598 DEVELOPMENT AND APPLICATION OF NEW TYPES OF NEUTRON FLUX DETECTORS IN POWER REACTORS. Gebureck, P. (Technische Univ. Hannover (F. R. Germany). Inst. fuer Kerntechnik). VGB Kraftwerkstechnik; 54: No. 12, 816-821(Dec 1974). (In German).

In recent years experimental and theoretical investigations into various in-core detectors have been carried out. The object has been to develop a new type of nuclear instrumentation for power reactors ("self-powered" detectors) which would enable systems used hitherto to be replaced or supplemented to advantage by those offering greater reliability and availability, multiple possibilities of application, and lower cost. (GE)

35599 CIRCULATING DEVICE FOR THE GAS COOLANT IN A REACTOR PRESSURE VESSEL. Fraser, W. M.; Cairns, W. J.; MacDonald, I. N. (to Howden (James) and Co. Ltd., Glasgow (UK)). German(FRG) Patent 1,802,582/B/. 18 Jan 1973. 3p. (In German).

The object of the invention is a circulating device, which during the operation of the reactor, without impairing its function, can be brought to a stop and all of its parts prone to wearing can be serviced from outside. This takes place by means of an ingenious arrangement of flange, spacer ring and locking cap which surround the blower on the inner side of the pressure vessel. The technical details and their functions are dealt with in the patent. (GE)

35600 OPERATING EXPERIENCE WITH HEAT EXCHANGERS IN NUCLEAR POWER STATIONS WITH LIGHT WATER REACTORS. Baschek, H.; Kocourek, E. (Nordostschweizerische Kraftwerke A. G., Doettingen. Kernkraftwerk Beznau). VGB Kraftwerkstechnik; 54: No. 12, 799-807(Dec 1974). (In German).

Operating experience with primary heat exchangers in light water reactor power stations with particular reference to the Beznau I and II plants is discussed. In the ever increasing number of pipe failures in steam generators it is in most cases the result of a relatively slowly progressing, local corrosive attack on the pipework material on the secondary side. Only in isolated cases was it a question of leakages which were fully controllable from the technical safety point of view. The various faults are described in some detail and the influence of the factors—design, material, and chemistry — is briefly discussed. (auth)

35601 CYCLIC DEFORMATION AND FATIGUE ANALYSIS FOR NOTCHED COMPONENTS. Leis, B. N.; Topper, T. H. (Waterloo Univ., Ontario (Canada)). Nucl. Eng. Des.; 29: No. 3, 370-383(1974).

From 2nd international conference on structural mechanics in reactor technology; Berlin, Germany (10 Sep 1973).

The design of cyclically loaded members—an area of major concern to design engineers—is a complex iterative process fraught with uncertainty. At present the effect of factors such as geometric discontinuities is not completely understood and the evolution of a fatigue resistant structure from an initial design based largely on experience and empiricism is accompanied by extensive reliability testing. This design process, although effective, is expensive and time consuming. Therefore, several authors have sought an analytic procedure which models the fatigue process in terms of a deterministic mathematical description. This paper examines the decreased severity of notches in fatigue when compared with the severity predicted by deformation analysis in terms of a number of factors which may influence this behavior. These factors include the inelastic deformation analysis used, the failure criterion selected for smooth and notched samples and the local stress state in the notched sample. The failure criterion selected was found to have a marked influence on the value of the fatigue notch factor K_f at all fatigue lives while, as expected, the inelastic deformation was important only in the low and intermediate life regimes. Experimental results indicated that the deformation analyses used did not adequately predict the inelastic deformation behavior at the notch root. A solution for local biaxial fatigue criterion was used to predict the variation of the fatigue concentration factor with thickness in plate specimens. Agreement of these predictions with experimental results was excellent. (auth)

35602 EXPERIENCE IN INDUCTION HEAT TREATMENT OF WELDS AND CLADDINGS ON NUCLEAR COMPONENTS. Mueller, H. H. pp 23-25 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

A welding method using induction heat treatment of welds in the construction of reactor components is described. The selection of the construction material and the welding conditions for reactor pressure vessels is outlined. The procedure for the preheating is described. Heat treatment after welding to avoid

35603 QUALITY ASSURANCE DURING MANUFACTURING OF PRIMARY COOLANT CIRCUIT COMPONENTS FOR NUCLEAR POWER PLANT WITH SPECIAL REGARD TO FILLER MATERIALS, FLUXES, AND GASES. Schueler, R.; Maidorn, C.; Austel, W. pp 215-219 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The criteria of quality assurance are outlined and a quality assurance system is described. The relation between production and inspection, beginning with the melting process and ending with the finished product, is considered. The application of quality assurance systems to welding is discussed and the safety of components manufactured under such a system is analyzed. (JSR)

35604 WELDING TECHNICAL TASKS BY MANUFACTURE OF VALVES FOR NUCLEAR POWER STATIONS. Kilian, H. J. pp 233-237 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The specifications placed on the design and materials for reactor valves are summarized. The necessity for standardization in the evaluation of weld joints and seams is emphasized. The application of standardization factors to the preliminary processing of individual units of valves, joint welding, welding procedures, calk welding, postheating, and welding control are discussed. Testing and documentation of test results are also briefly considered. (JSR)

35605 ULTRASONIC TESTING SYSTEMS AND DATA PROCESSING FOR THE PRE-SERVICE AND IN-SERVICE INSPECTION OF NUCLEAR PRESSURE VESSELS. de Raad, J. A.; Engl, G. pp 255-262 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The system developed for the pre-service and in-service inspection of reactor pressure vessels based on the ultrasonic tandem-echo-transfer system is described in detail. The testing of the system showed that the electronically controlled multichannel ultrasonic equipment and manipulator gave extremely good reproducibility of the measurements. The procedures for the acquisition, storage, and processing of data from the ultrasonic system are described. (JSR)

35606 STRUCTURAL SAFETY ANALYSIS OF REACTOR COMPONENTS IN MANUFACTURE, OPERATION, AND IN-SERVICE INSPECTION. Bartholome, G.; Vasoukis, G. pp 267-272 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974). (In German).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

The most important defects in welded reactor components are cracks in the cladding components (underclad cracks), cracks in the heat-affected zone, and cracks in the base material. The possible origin of these defects is briefly discussed. Methods for evaluating these defects include stress analysis, defect analysis (non-destructive), and materials analysis (destructive). Each of these is described with respect to its use in the evaluation of the structural safety of reactor components. The evaluation of manufacturing defects is briefly considered, but the emphasis is on the detection of defects during operation. The use of brittle fracture diagrams and fracture mechanics diagrams is examined and the methods given in the ASME code are outlined. (JSR)

35607 REMOTE MAINTENANCE OF NUCLEAR STEAM GENERATORS. Stark, L. E.; Brown, E. L.; Johnson, W. R. pp 275-282 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

Explosive plugging was found to be a practical procedure for sealing off defective nuclear steam generator tubes. Explosive sleeve welding can be used to seal off a leak within the tubesheet area. A brazing procedure utilizing explosive expansion can be used outside of the tubesheet. This method is, however, inherently more complex and time consuming than explosive plugging or explosive sleeve welding. A combination of explosive welding and brazing can be used in the area of the secondary side of the tubesheet. (auth)

35608 INSPECTION AND EXPLOSIVE WELD PLUGGING OF DEFECTIVE TUBING IN A FERRITIC HEAT EXCHANGER. Watkins, B.; Dickinson, F. S. pp 305-308 of Welding in Nuclear Engineering. Dusseldorf; Deutscher Verlag fuer Schweisstechnik (DVS) GmbH (1974).

From 2nd symposium on welding in nuclear engineering; Dusseldorf, F. R. Germany (23 Oct 1974). See CONF-741092-.

Visual and eddy current inspections were used to determine the extent of pitting corrosion in reactor tubing. An investigation of explosive welding for tubes and for plugs into tube plates showed that: (1) the charge weight can be varied by at least ±5% in making acceptable welds; (2) holes of appreciably different diameters (30% oversize) can be plugged, provided plug clearance is within tolerance, without altering the explosive charge; (3) there is no dependence on material composition control as in fusion welding, and dissimilar welding is no problem; (4) there are no requirements for pre- or post-heat treatments to obtain the required mechanical performance; and (5) ultrasonic testing of the weld is a viable form of NDT. (PMA)

35609 REQUIRED CHARACTERISTICS AND QUALITY STANDARD OF STAINLESS STEEL TUBES FOR FEED WATER HEATERS IN NUCLEAR POWER PLANTS. Hamada, H. (Kobe Steel, Ltd. (Japan)). FAPIG (Tokyo); No. 71, 176-182(Nov 1973). (In Japanese).

A large number of tubes are required for feedwater heaters in nuclear power plants. Requirements for the tubes are freedom from internal and surface defects and resistance to stress corrosion cracking. Important points considered in manufacturing techniques are resistance to stress corrosion cracking and quality assurance. Stress corrosion cracking factors regarding materials are residual stress, Cl ions and other residual contaminating substances and corrosion at grain boundaries. Efforts were exerted for the reduction of these causes. Non-destructive inspection of products was made to maintain the quality of the tubes. Supersonic tests, permeation-fluorescence tests and eddy current tests were performed. Content of P and S was kept below JIS values. Inspection of quality was made by chemical composition analysis, non-destructive tests, dimensional inspection, mechanical tests, microscopic tests, tests of corrosion at grain boundary, stress corrosion cracking tests, and tests for the corrosion resistance of annealed parts. The results of all the tests satisfied specified requirements. (JA)

35610 PRESTRESSED CONCRETE PRESSURE VESSEL AND ITS BREAKING TEST. I. Kawamata, S. (Tokyo Univ. (Japan). Inst. of Industrial Science). FAPIG (Tokyo); No. 71, 150-155(Nov 1973). (In Japanese).

Prestressed concrete pressure vessels (PCPV) have been in use as reactor vessels since 1958. Concrete vessels can be constructed more easily than thick steel vessels and are therefore advantageous for large power reactors. Characteristics of PCPV are as follows: (1) failure due to over-pressure from inside is gradual, (2) primary cooling system can be contained in the vessel, and (3) seismic strength is high. However, stress analysis is very difficult. A program for analysis by finite element method was developed, and a model experiment to study deformation and failure of prestressed concrete pillars is described. (JA)

Reactor Fuels

Refer also to abstracts 32649, 33714, 33715, 33740, 33758, 33864, 33892, 34131, and 34778.

35611 (EPRI-SR-1) THERM: TRANSIENT THERMAL ANALYSIS OF A NUCLEAR FUEL ROD. (Electric Power Research Inst., Palo Alto, Calif. (USA)). Mar 1975. 40p. Dep. NTIS $4.00.

THERM is a finite difference conduction-convection computer program, written in FORTRAN IV, designed to predict the transient thermal response of a reactor fuel rod and coolant channel to reactivity or flow perturbations. It was developed to handle large and rapid transients in the minimum computation time; hence, stability and speed were the most important criteria in its design. Cylindrical geometry is assumed. The rod and coolant channel are divided into a user input number of axial divisions. Within each axial section heat generation is assumed uniform, and heat conduction is in the radial direction only. The user may specify the number of nodes in the fuel and cladding. Single phase flow is assumed. The program requires numerical input data that specify the initial conditions and the heat generation in the fuel, mass flow rate of the coolant and the inlet temperature of the coolant as functions of time. In addition, the user may specify constant values of thermal conductivity and heat transfer coefficients or provide tables, which the code uses to calculate variable properties. (auth)

Reactor Control Systems

Refer also to abstracts 35172 and 35537.

35612 (AGC-1741(Vol.1)) DESIGN STUDY OF ENGINE CONTROLS AND REACTOR INSTRUMENTATION FOR A NUCLEAR FLIGHT TEST ENGINE. Final Data Report. Schaffer, D. J. (Bendix Corp., Southfield, Mich. (USA). Research Labs. Div.). 28 Feb 1961. 217p. Dep. NTIS $14.00.

For Aerojet General Corp., Azusa, CA.

This data report includes final design studies of engine controls, reactor instrumentation and auxiliary power supplies; final studies of the interaction effects between the engine system and telemetry and guidance; ground test instrumentation requirements; reactor power control sub-loop studies; information requested by Aerojet for their proposal appendices; and information pertinent to the request for porposal issued by NASA for the NERVA Project. Preliminary designs will be reviewed and modified, supplemented, or corrected as necessary prior to incorporation into the final report. (auth)

35613 (CEA-CONF-2725) SENSITIVITY OF NEUTRON CONTROL AND MEASUREMENT SYSTEMS TO PARASITICS. Development of New Cables. Buisson, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Services d'Electronique). 28 Mar 1974. 11p. (In French). (CEA-SES-PUB-SAI-74-68). INIS.

From 46th meeting of the national team for methods of the Central Arming Laboratory; Arcueil, France (30 May 1974).

A study on the action of parasitics in neutron control units (start-up lines and FEDAL) led to the definition of an interconnection technology (cables, connectors, sealed passages) which guarantees a unit against any need for adjustment on the site. (FR)

35614 (RN-DR-0190A) ADDENDUM PROGRAM PLAN FOR THE DEVELOPMENT OF THE INSTRUMENTATION AND CONTROL (I AND C) SYSTEM FOR THE NERVA ENGINE. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Apr 1970. 130p. Dep. NTIS $9.50.

This addendum program plan is prepared in response to the stipulation that the digital I&C System is the reference concept. The plan was developed on the basis of the following assumptions: (1) The basic I&C requirements have already been established by SNPO and are not changed as a result of the change from an analog to a digital control approach. (2) There are no major state-of-the-art advances or similar technical problems which will critically impede performance. (3) The major part of the technical knowledge and manufacturing skills required to implement this program already exist. (4) Modern control theory will be used to develop the control system. Trade and design studies would require re-scoping and re-direction to support the digital approach. The results of these studies and investigations indicate that the NERVA I&C System, using a digital approach, can be implemented, for the R-1 and fully for the E-1 test, leading to a compact digital system package for the flight engine. (auth)

35615 (TID/SNA-807) FLIGHT AND GROUND TEST CONTROL INTEGRATION PLAN. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jan 1971. 56p. Dep. NTIS $6.00.

This plan describes the functions to be accomplished in providing the Control System in support of the NERVA engine testing at ETS-1. It serves the project engineer as a source of information for the planning and design of Test Support Equipment identified as the Ground Test Control System (GTCS). It describes the overall Engine Control System integration studies required and programs used as guides by the equipment and system designers. (auth)

35616 (WANL-TME-1169) NRX-A3 EP-VI CONTROL TEST ANALYSIS AND SIMULATION. Cooper, K.; Junker, D. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 24 May 1965. 25p. Dep. NTIS $4.25.

35617 (WANL-TME-1714) XE-1 NUCLEAR SUBSYSTEM CONTROL SYSTEM DESCRIPTION REPORT. Sossman, C. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 4 Jan 1968. 211p. Dep. NTIS $13.75.

A description of the XE-1 Nuclear Subsystem Control and Reactor Safety System, including the controller transfer functions is presented. In the discussion of the control systems, the method of implementing the control modes, the respective measured variable, control and demand signal origin, and transfer function of the various control systems will be presented. The control systems discussed are: Power control; temperature control; control drum position control; and automatic startup. The safety systems discussed are: Overrides; power and temperature mode inhibits; and the scram chain. The discussion of the scram chain will identify each monitored item and describe how a scram condition is determined. (auth)

35618 (WANL-TMI-1500) CONTROL DRUM FRICTION TEST. Kallin, I. N. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 2 Jul 1965. 4p. Dep. NTIS $4.00.

A rubbing test was performed with a control drum and a beryllium pad machined to simulate the beryllium sector bore. The objective of this test was to determine what surface damage would result to the drum under the following loading condition: (1) drum bowed about .065 inch; (2) radial load of 800 lb applied; and (3) 5° drum rotation and return. It also required to measure the torque necessary to produce this rotation. (auth)

35619 (WANL-TMI-1766) ACTUATION SYSTEM FOR GANGED DRUMS. Kirschbaum, H. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1967. 13p. Dep. NTIS $4.00.

The proposed actuation system to be used with a set of ganged drums is illustrative of the benefits which can be reaped from the application of redundancy techniques to enhance the reliability of existing hardware. The system is not necessarily proposed as the best system for the NERVA program, but is presented as an incentive to explore in depth the application of redundancy techniques in such a manner that the fruits of the technology program are used to the maximum extent possible. It is recommended that systems similar to the proposed system be studied in depth with the objective of optimizing reliability, cost, and weight. Furthermore, studies are required to optimally set the decoupling torque levels so as to result in minimum perturbation to the system when decoupling occurs. (auth)

35620 INSTRUMENTATION AND SUPERVISION OF THE DYNAMIC BEHAVIOUR OF POWER REACTORS. Schruefer, E. (Kraftwerk Union A. G., Offenbach (F. R. Germany). Abt. Reaktorinstrumentierung und -regelung). At. Strom; 20: No. 11/12, 122-126(Nov 1974). (In German).

5 figs.; 1 tab.; 16 refs.

The instrumentation of a power reactor is considered with regard to the rate at which measuring instruments can follow a change in the variable to be measured. The transition function and the frequency response curve are defined, and the time behavior of different measuring transducers is investigated. (GE)

35621 NUCLEAR REACTOR CONTROLLING DEVICE. Yamada, S.; Kage, H. (to Hitachi Ltd., Tokyo (Japan)). Japanese Patent 1973-26717/B/. 17 Apr 1967. 3p. (In Japanese).

A reactor according to the present invention comprises a fuel assembly, an inner conduit enclosing the fuel assembly, and an outer conduit which is coaxial and rotatable relative to the inner conduit. The inner and outer conduit have a plurality of control rods incorporated within their walls. The control rods may be inserted into and withdrawn from the walls of the conduits. The relative rotation of the conduits changes the relative positions of the control rods. The excess multiplication constant k_{ex} of the reactor may be controlled by rotating one of the conduits relative to the other conduit in response to the burnup of fuels. (JA)

Nuclear Power Plant Economics

Refer also to abstract 35160.

35622 (AED-CONF-74-422-001) ELECTRICAL POWER GENERATION AND ENERGY CARRIERS TODAY. Pink, H. R. (Kraftwerk Union A. G., Offenbach (F.R. Germany). Vertriebsbereich Zentrale Technik). 1974. 30p. (In German). INIS.

From lecture meeting of the VDE-Bezirksverein Nordbayern; Nuernberg, F.R. Germany (5 May 1974).

A survey of the primary energy carriers and their use for the production of energy is given. The use of nuclear energy is emphasized. The effects of current generating plants on the environment are described. (GE)

35623 (LA-UR-75-215) MODELING MAXIMUM LIKELIHOOD ESTIMATION OF AVAILABILITY. Waller, R. A.; Rock, G. W.; Tietjen, G. L. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 15p. (CONF-750426-1). Dep. NTIS $4.00.

From international optical computing conference; Washington, District of Columbia, USA (23 Apr 1975).

One method of estimating the performance of a power plant when the measure of performance is availability is presented. The probability that the plant is operational at time "t" is de-

termined. To study the availability of a power plant, statistical models are assumed for the variables, X and Y, which denote the time-to-failure and the time-to-repair variables, respectively. Once those statistical models are specified, the availability, A(t), can be expressed as a function of some or all of their parameters. Usually those parameters are unknown in practice and so A(t) is unknown. The maximum likelihood estimator of A(t), say A(t), is analyzed for the time-to-failure model for X being an exponential density with parameter, λ, and the time-to-repair model for Y being an exponential density with parameter, θ. (7 references) (auth)

35624 COMMENT OF THE DAtF ON THE ENERGY PROGRAM OF THE GERMAN FEDERAL GOVERNMENT. Atomwirt., Atomtech.; 19: No. 11, A368-A371 (Nov 1974). (In German).

Included are comments on the following topics: (1) starting situation, (2) efficiency of the nuclear power plant industry, (3) fuel cycle, (4) sites, (5) licensing procedures, (6) financing, and (7) research and development. (GE)

35625 HEAT SUPPLY BY NUCLEAR POWER PLANTS. Kraemer, H.; Schlenker, H. V. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). Atomwirt., Atomtech.; 20: No. 1, 35-42(Jan 1975). (In German).

The cost-structure of the different energy sources has changed considerably to the disadvantage of fossil energies. As energy needs will probably increase in all sectors, a broad and technically realizable application of nuclear energy seems to be economically interesting in the future in a non-electrical energy market. In the first instance the heat-power coupling may be placed in the forefront. The light-water reactor is a proven power plant system which could be offered on the energy market today. Significant advantages in comparison with the light-water reactor are offered with the high-temperature reactor with double cycle, and especially with direct cycle, being available in early or mid-1980's. Another important component in the late 1980's may be the production of synthetic gases, which are produced by nuclear gasification in high-temperature reactors and used in recycling processes. (auth)

Reactor Licensing and Regulation

35626 (DOCKET-50213-392) HADDAM NECK PLANT. Semiannual Operating Report, July–December 1974. (Connecticut Yankee Atomic Power Co., Hartford (USA)). 26 Feb 1975. 40p. Dep. NTIS $5.00.

Net electrical power generated was 2,382,401.6 MW(e), the reactor was critical 4,406.8 hours and the generator was on the line 4,370.7 hours. Information is presented concerning operations, shutdowns, maintenance, changes, tests, experiments, plant operating procedures, changes in personnel, performance, surveillance, power generation, primary coolant chemistry, solid waste shipments, transfer of special nuclear materials, occupational personnel radiation exposures, radioactive effluent releases, and environmental monitoring. (FS)

35627 (DOCKET-50244-382) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Tenth Semiannual Operations Report, July–December 1974. (Rochester Gas and Electric Corp., N. Y. (USA)). 27 Feb 1975. 44p. Dep. NTIS $5.25.

During this period, unit power levels ranged from zero to 100% of full licensed power (1520 MW(t)). The reactor core operated without difficulty and with no indication of fuel failure. Information is presented concerning operations, modifications, procedure and personnel changes, surveillance, containment leak rate tests, training, power generation, shutdowns, maintenance, effluents, solid wastes, environmental monitoring, and primary coolant chemistry. (FS)

35628 (DOCKET-50254-553) QUAD-CITIES STATION, UNITS 1 AND 2. Semiannual Operating Report, July–December 1974. (Commonwealth Edison Co., Chicago, Ill. (USA)). 20 Feb 1975. 78p. (DOCKET-50265-494). Dep. NTIS $7.00.

During this period, Unit 1 generated 2,199,872 MWH net electric power with the reactor operating for 3,611.9 hours and the generator on line for 3,440.8 hours. Unit 2 generated 2,035,325 MWH net electric power with the reactor operating for 3,724.1 hours and the generator on line 3,634.0 hours. Information is presented concerning operations, power generation, shutdowns, maintenance, changes, tests, and experiments. (FS)

35629 (DOCKET-50255-456) PALISADES NUCLEAR PLANT. Semiannual Operations Report, July–December 1974. (Consumers Power Co., Jackson, Mich. (USA)). 28 Feb 1975. 51p. Dep. NTIS $5.75.

The plant was on line October 1, 1974 for the first time since August 11, 1973 and operated through October 17, 1974 before it was removed from service for operator licensing demonstrations and repairs. Two short periods of outage time were experienced in the above 17-day period. The unit was again on line October 27 and operated through November 1 before being removed from service to repair the main condenser. License approval was received to conduct power operation for a 90-day period after the repairs were completed in the steam generators. This approval allowed the initiation of our program to remove chemical impurities from the steam generators. On September 5 the reactor was taken critical and, while rolling the turbine generator on September 6, turbine blading damage was experienced due to excessive tube leakage from the No. 1 and No. 2 feedwater heaters. Temporary repairs were affected and the unit was returned to service on October 1. During the outage period of November 1 through the end of the report period, the main condenser was retubed, the last two stages of blading were repaired or replaced in "B" LP turbine, and other necessary work was performed. Cooling towers were initially operated at this time. Information is presented concerning operations power generation, maintenance, changes, radioactive effluent releases, and environmental monitoring. (FS)

35630 (DOCKET-50259-541) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1 AND 2. Semiannual Report, July–December 1974 and Appendix A–Water Quality and Biological Conditions in Wheeler Reservoir, July–December 1974. (Tennessee Valley Authority, Chattanooga (USA)). 28 Feb 1975. 151p. (DOCKET-50260-323). Dep. NTIS $10.75.

During the period net electrical power generated by Unit 1 was 3,538,649 MWH. Unit 2 was declared commercial on August 1, 1974 and generated 1,117,715 MWH in this period. Information is presented concerning operations, power generation and shutdowns, maintenance, changes, primary coolant chemistry, occupational personnel radiation exposures, effluent releases, solid radioactive waste, source tests, non-radiological environment in-plant monitoring, environmental monitoring and the radiological impact assessment. (FS)

35631 (DOCKET-50263-469) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Semiannual Operating Report No. 8, July–December 1974. (Northern States Power Co., Minneapolis, Minn. (USA)). 28 Feb 1975. 54p. Dep. NTIS $5.75.

Monticello generated 1,779,695 MWH net electrical power, was critical 4,226 hours and the generator was on line 4,034 hours. Information is presented concerning operations, shutdowns, maintenance, changes, tests, experiments, radioactive effluent releases, and radiation environmental monitoring. (FS)

35632 (DOCKET-50266-263) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Semiannual Operation Report No. 9, July–December 1974. (Wisconsin Electric Power Co., Milwaukee (USA)). 1974. 118p. (DOCKET-50301-238). Dep. NTIS $9.00.

Unit 1 operated on load follow throughout the period, generating at an average capacity factor of 92.13% with a net efficiency of 31.42%. The percentage plant and reactor availability were 97.42% and 99.04%. Unit 2 was essentially base loaded with a nine week refueling shutdown and turbine overhaul. Unit 2 operated at an average capacity factor of 59.25% with a net efficiency of 31.08%. Percentage plant and reactor availability were 62.25% and 65.61%. Information is provided concerning operations, maintenance, instrumentation and control, chemistry, health physics and safety, abnormal occurrences, design changes, plant performance, and environmental effects. (FS)

35633 (DOCKET-50267-250) FORT ST. VRAIN NUCLEAR GENERATING STATION. Semiannual Operating Report, July–December 1974. (Public Service Co. of Colorado, Denver (USA)). 28 Feb 1975. 53p. Dep. NTIS $5.75.

During the period the A-series Start-up Tests were completed. The core was heated to 300°F with steam in the reheaters, new forged Pelton wheels were installed on the four helium circulators, the hydrodynamic test of feedwater control and steam generators was run, and the problem of attaining the specified water chemistry for feedwater and condensate limits was solved. No electrical generation occurred but the reactor was critical for 132 hours. Information is presented concerning operations, maintenance, testing, radioactive effluent releases, solid wastes, coolant chemistry, and personnel changes. (FS)

35634 (DOCKET-50267-254) FORT ST. VRAIN NUCLEAR GENERATING STATION. Semi-Annual Operating Report No. 2, July–December 1974. (Public Service Co. of Colorado, Denver (USA)). 14 Mar 1975. 61p. Dep. NTIS $6.25.

The A-series start-up tests, core heatup to 300°F with steam in the reheaters, installation of new forged Pelton wheels on the four

helium circulators, and hydrodynamic tests of feedwater control and steam generator were accomplished and the problem of attaining the specified water chemistry for feedwater and condensate limits was solved. No electric generation occurred but the reactor was critical for 132 hours. Information is presented concerning maintenance, technical specification surveillance testing, health physics and chemistry, radioactive effluent production, meteorology data, and changes to the plant. (FS)

35635 (DOCKET-50269-337) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Semiannual Operating Report and Nonradiological Environmental Specifications, June–December 1974. (Duke Power Co., Charlotte, N. C. (USA)). 28 Feb 1975. 627p. (DOCKET-50270-290; DOCKET-50287-221). Dep. NTIS $34.50.

Facility operations including design changes, performance characteristics, operating changes, surveillance, tests, inspections, containment leak tests, maintenance, primary coolant chemistry, and radioactive effluent releases are summarized. Information is presented concerning station cooling water systems, chemical discharges, aquatic surveillance, fish impingement, plankton entrainment, plume mapping, gas bubble disease, and water quality data for Lakes Keowee and Hartwell. (FS)

35636 (DOCKET-50282-343) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Semiannual Operating Report No. 3, July 1–December 31, 1974. (Northern States Power Co., Minneapolis, Minn. (USA)). 28 Feb 1975. 85p. (DOCKET-50306-243). Dep. NTIS $7.25.

Operations including chronological history, changes in plant design, performance characteristics, procedure changes, results of surveillance, tests and inspections, changes in personnel, and occupational personnel radiation exposure are summarized. Information concerning power generation and shutdowns, maintenance, radioactive effluent releases, and radiation environmental monitoring is presented. (FS)

35637 (DOCKET-50298-321) COOPER NUCLEAR STATION. Semiannual Operating Report, July–December 1974. (Nebraska Public Power District, Columbus (USA)). 28 Feb 1975. 108p. Dep. NTIS $8.50.

Net electrical power generated was 1,740,474 MWH with the generator on line 1,084.5 hrs. Reactor availability was 80.1% and the generator availability was 74.5%. Information is presented concerning operations, performance characteristics, facility changes, personnel changes, maintenance, effluent and waste disposal, and personnel radiation exposures. (FS)

35638 (DOCKET-50305-281) KEWAUNEE NUCLEAR POWER PLANT. Semiannual Operating Report, July–December 1974. (Wisconsin Public Service Corp., Green Bay (USA)). 28 Feb 1975. 243p. Dep. NTIS $15.25.

Since the plant was declared commercial on June 16, 1974, Kewaunee has generated 1,683,400 MW hours of electricity through December 31, 1974, with a net plant efficiency of 31.57%. Net plant capacity was 62.19%, reactor availability was 79.08%, and plant availability was 75.18%. Information concerning operations, maintenance and inspections, instrumentation and control, radiation chemistry, primary coolant chemistry, health physics, design changes, reactor engineering, and radiological monitoring is presented. (FS)

35639 (FIND-50348-R1) FIND: JOSEPH M. FARLEY NUCLEAR POWER PLANT, UNITS 1 AND 2. Williams, W. H. (ed.). (USERDA Technical Information Center, Oak Ridge, Tenn.). Mar 1975. 35p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (auth)

35640 (NRCI-75/2) NUCLEAR REGULATORY COMMISSION ISSUANCES, FEBRUARY 1975. (USERDA Technical Information Center, Oak Ridge, Tenn.). Mar 1975. 125p. TIC $4.00.

Issuances received from the U. S. Nuclear Regulatory Commission, the Atomic Safety and Licensing Appeal Boards, and the Atomic Safety and Licensing Boards are presented. (DCC)

35641 (TID-26713) SELECTED ISSUANCES OF THE ATOMIC ENERGY COMMISION AND THE HEARING BOARD IN THE RULE MAKING PROCEEDINGS ON ACCEPTANCE CRITERIA FOR EMERGENCY CORE COOLING SYSTEMS FOR LIGHT-WATER-COOLED NUCLEAR POWER REACTORS (DOCKET-RM-50-1). (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Mar 1975. 59p. Dep. NTIS $5.45.

35642 LONG-TERM STRATEGY FOR ATOMIC POWER DEVELOPMENT. Murata, H. (Japan Atomic Energy Research Inst., Tokyo). At. Jap.; 18: No. 4, Suppl., 121-126(Apr 1974).

From 7th annual conference of the Japan Atomic Industrial Forum; Tokyo, Japan (5 Mar 1974).

Personal thoughts on "long-term strategy for atomic power development" for Japan are presented, which are in the main based on the similar conference held by the IAEA. The impression gained from this meeting is first explained, concerning especially environmental conservation. The future target for Japan is to achieve nuclear fusion reactors as early as possible. In the meantime, it is necessary to develop HTGR and FBR rather than LWR. Eventually, it is desirable to develop what is called Fusion Fission Hybrid Reactor (FFHR), associated with a very High Temperature Reactor (VHTR). (JA)

35643 NUCLEAR POWER DEVELOPMENT PROGRAM WITH NEW PHILOSOPHY. Commissioner Inaba Announces Medium-Term Prospect and JAIF Starts Study with New Approach. At. Jap.; 18: No. 3-4, 15-26(Mar 1974).

In the face of the energy crisis centered on petroleum shortage, Japan's policy toward economic growth, and hence overall energy consumption, is forced to modify its course. To be more realistic, the JAIF is working out the comprehensive action program for the immediate future, involving general matters, siting, safety and environment, nuclear fuel, and technology and development. The background for this and respective aspects are explained. In the same line, AEC commissioner Inaba has formulated the plans up to 1985, assuming three cases of energy demand and supply, with the minimum target of 60 million KW for nuclear power generation. Future prospects in connection with economic growth rate and energy supplies are described. (JA)

35644 THE TECHNICAL SURVEILLANCE ASSOCIATIONS (TUeV) AND THEIR ROLE AS EXPERT AND EXAMINER IN THE NUCLEAR LICENSING PROCEDURE. Vetter, H. (Technischer Ueberwachungs-Verein Baden e.V., Mannheim (F. R. Germany)). Tech. Ueberwach.; 15: No. 12, 431-435(1974). (In German).

From lecture meeting on energy and environment; Duesseldorf, F. R. Germany (5 Dec 1974). 2 figs.; 2 refs.

The objectives of the Atomic Energy Law, the competences of the various authorities (Laender authorities), and the tasks and activities of the Technical Surveillance Associations and the Institute for Reactor Safety (IRS) in their capacity as advisers and experts acting on behalf of the Laender authorities in the evaluation of the safety of nuclear power plants and in the regular surveillance of their operation are briefly outlined and discussed from the expert's point of view. Reviewing the experience up to date, it is noted that the experts opinions given have not always been in agreement with each other, but it is stated at the same time that uniformity and better agreement of evaluation results and experts opinions can only be achieved in the nuclear field by rationalizing and standardizing the nuclear licensing procedure. (GE)

35645 IAEA 1975: BETWEEN ENERGY CRISIS AND NUCLEAR SAFEGUARDS. Rembser, J. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany)). Atomwirt., Atomtech.; 19: No. 12, 604-605(Dec 1974). (In German).

The 18th general conference of the International Atomic Energy Agency in Vienna in September 1974 has been of particular importance due to two main events: the energy crisis and the first nuclear explosion in India. They influenced the discussions and considerations on programmes for intensified efforts to extend the nuclear power plant network and their supply in the fuel cycle as well considerations concerning the coming first conference to review the non-proliferation treaty. (GE)

GENERAL AND MISCELLANEOUS

Civilian Defense

35646 (AD/A-001480) PROTECTION FROM RADIOACTIVE SUBSTANCES. Sudakov, A. K. 30 Oct 1974. Translated by J. F. Eros from pp 27-37 of Zashchita Naseleniya ot Radioaktivnykh Osadkov, Moscow, 1964. (FSTC-HT-23-1094-73). 11p. NTIS $3.25.

Law

Refer also to abstract 33468.

35647 (NTIS/PS-74/134) OCEAN LAW. A Bibliography with Abstracts. Report for 1964–October 1974. Brown, R. J. (National Technical Information Service, Springfield, Va. (USA)). Dec 1974. 139p. NTIS $20.00.

The bibliography contains 123 selected abstracts of research reports retrieved using the NTIS on-line search system — NTISEARCH. The cited reports cover national and international laws on fishing, undersea mining, shipping, territorial waters, undersea mineral deposits, and water pollution. (GRA)

35648 CURRENT STATUS OF PRICE–ANDERSON. Gehr, A. C. (Snell and Wilmer, Phoenix, AZ). Forum (Chicago); 10: No. 3, 1168-1186(Spr 1975).

The background of the Price-Anderson Act is reviewed. With proposals by industry to participate in the development of nuclear power for peaceful uses, new legislation was needed to solve insurance and liability responsibilities presented by the new technology. The Price-Anderson Act was passed in 1957 "to protect the public and to encourage the development of the atomic energy industry." The provisions are reviewed. The Act provided that if a construction permit for any particular project were issued prior to August 1, 1977, the Price-Anderson protection would attach when the plant is constructed and issued a license to operate and would continue for the life of the plant. Previously, thirty-four months were necessary for processing applications, and it is projected that additional years are now required. Efforts were begun in 1972 to consider the extension of Price-Anderson which provides for financial protection for nuclear plants. Two studies were undertaken on May 25, 1974 by the Atomic Energy Commission to provide a basis for recommendations on the extension of the Act. The first was to be a probabilistic reactor safety study, including analyses of the probabilities and sequences of postulated nuclear accidents that could result in the release of radioactivity, evaluation of the nature of such release, and a comparison of nuclear risks with other risks associated with fossil-fueled power plants and other risks encountered in the modern world. The second study involved a re-examination of the rationale and desirability of Price-Anderson and each of its separate elements. Recommendations were due in Congress in early 1974. After these and other studies were completed, the new bill designated as H. R. 15323 was introduced. The bill passed the House. The Senate proposed three amendments to the House version. The Senate requested a conference with the House, and the Senate members of the JCAE were designated as the Senate members of the conference committee. At this date the House members of the committee have not been designated. (MCW)

35649 AEC WEAPONS PROGRAM AUTHORIZATION REQUEST, FISCAL YEAR 1975. Hearing Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, Second Session to Consider the Fiscal Year 1975 Funding Request for the AEC Nuclear Weapons Program, February 20, 1974. Washington, DC; Joint Committee on Atomic Energy (1975). 19p. GPO $0.30.

Testimony given before the Joint Committee on Atomic Energy on the fiscal year 1975 AEC authorization request relating to the Commission's nuclear weapons program is presented. (TFD)

35650 PROPOSED EXTENSION OF EXISTING RESEARCH AGREEMENT FOR COOPERATION BETWEEN THE UNITED STATES AND ISRAEL CONCERNING CIVIL USES OF ATOMIC ENERGY, SENATE, NINETY-FOURTH CONGRESS, FIRST SESSION, FEBRUARY 13, 1974. Washington, DC; Joint Committee on Atomic Energy (1975). 10p. GPO.

The Joint Committee on Atomic Energy, having considered S. Con. Res. 15, a resolution expressing the approval of the Congress of the amendment to the 1955 "Agreement for Cooperation Between the Government of the United States of America and the Government of Israel Concerning Civil Uses of Atomic Energy" proposed by the Atomic Energy Commission on January 14, 1975, reports without amendment the concurrent resolution and recommends that the concurrent resolution does pass. (auth)

35651 PROPOSED INCREASE IN THE AMOUNT OF ENRICHED URANIUM WHICH MAY BE DISTRIBUTED TO THE INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA), SENATE, NINETY-FOURTH CONGRESS, FIRST SESSION, FEBRUARY 13, 1975. Washington, DC; Joint Committee on Atomic Energy (1975). 6p. GPO.

The Joint Committee on Atomic Energy, having considered S. Con. Res. 13, a resolution expressing the approval of the Congress to the distribution of amounts of special nuclear material to the International Atomic Energy Agency, proposed by the Atomic Energy Commission on January 8, 1975, reports without amendment the resolution and recommend that the resolution do pass. (auth)

Management

35652 JAHRESBERICHT 1973. Kurzfassung. (Annual Report 1973. Compact Version). Muenchen, F. R. Germany; Sueddeutscher Verl. (1974). 236p. (In German).

Scientific reports of the institutes and departments, development of the society, and survey of publications and conference papers are presented. (GE)

Mathematics and Computers

35653 (CERN-74-23) PROCEEDINGS OF THE 1974 CERN SCHOOL OF COMPUTING, GODOEYSUND, NORWAY, 11–24 AUGUST 1974. (European Organization for Nuclear Research, Geneva (Switzerland)). 15 Nov 1974. 444p. Dep. NTIS (US Sales Only) $25.25.

Eleven lectures are presented on data processing and computer science topics that are complementary to experimental physics. Topics covered include computer systems architecture, logic, and software. (SFL)

For abstracts of individual papers see: 33259, 34582, and 35654–35662.

35654 (CERN-74-23, pp 1-64) INTRODUCTION TO COMPUTER SYSTEMS ARCHITECTURE: HARDWARE. Sumner, F. H. (Univ. of Manchester, Eng.). 15 Nov 1974.

In proceedings of the 1974 CERN school of computing, Godoeysund, Norway, 11–24 August 1974.

The development of computer systems hardware architecture is followed. The IBM approach with the development of the 1401 is followed by a discussion on the development of the computers in the 1960s that ran under the control of operating systems. The second part discusses addressing and store organization. The third section of the paper discusses computers of conventional design with specific reference to CDC 6600 IBM 360/195, and MU5. (22 references) (MCW)

35655 (CERN-74-23, pp 65-104) M.U.5 COMPUTER SYSTEM. Sumner, F. H. (Univ. of Manchester, Eng.). 15 Nov 1974.

In proceedings of the 1974 CERN school of computing, Godoeysund, Norway, 11–24 August 1974.

The design of the MU5 research computer is forecast to produce a high performance machine with a structure well suited to the needs of modern high level languages. Improvements in computing speed will be gained by adopting extensive parallel processing techniques, and by incorporating data buffering systems to compensate for the disparity between processor and storage speeds. The philosophy of the design, the instruction format, and the addressing structure are discussed. The MU5 computer system is a multiprocessor complex with processors and store units linked by an interconnection system, the Exchange. The computational power of the system is provided by the MU5 central processor, while a modified ICL 1905E processor provides the front end to the system. Each processor has its own fast store; a Mass core store and disc system provide backing storage. The MU5 Central Processing Unit utilizes a pipeline concurrency technique to obtain a fast instruction-processing rate. This requires the use of separate hardware units to implement the various operations involved in the execution of an instruction. The operation of the system is described. (MCW)

35656 (CERN-74-23, pp 105-187) INTRODUCTION TO COMPUTER SYSTEM ARCHITECTURE: SOFTWARE. Guiboud-Ribaud, S. H. (CII Scientific Centre, Grenoble, France). 15 Nov 1974.

In proceedings of the 1974 CERN school of computing, Godoeysund, Norway, 11–24 August 1974.

The historical evolution of computers is briefly discussed. Evaluation of costs, the computer as tool for the user, methodology, and distinction between language and system, are subjects covered in the Introductory section. Other sections are: Relations Between Machines and Languages; and Relations Between Machines and System. (52 references) (MCW)

35657 (CERN-74-23, pp 188-222) MULTIPROCESSOR SYSTEMS. Mazare, G. (CII Scientific Centre, Grenoble, France). 15 Nov 1974.

In proceedings of the 1974 CERN school of computing, Godoeysund, Norway, 11–24 August 1974.

Multiprocessor systems are characterized by the use of several processing units capable of doing work, motivated by the desire to go more quickly with several units than with one. The limits of one powerful machine are discussed, and efforts are now to use several processors and accomplish several tasks at the same time. The creation of Illiac IV attests to this. The prices of medium-sized processors are lowering, and these are the popular sizes. A first advantage of multiprocessors is the gain in execution speed and another advantage is the increase in reliability. Three types of multiprocessor systems are the array process that includes the ILLIAC IV; pipe-line processors; and multiple independent processors. The three processors could perform simultaneously. (MCW)

35658 (CERN-74-23, pp 223-262) SPECIAL PURPOSE PROCESSORS. Verkerk, C. (CERN, Geneva). 15 Nov 1974.

In proceedings of the 1974 CERN school of computing, Godoeysund, Norway, 11–24 August 1974.

Special purpose processors implemented in hardware are discussed by presentation of specific examples of processors. A definition of a special purpose processor for this presentation only is that it is a piece of hardware designed to fit as closely as possible the algorithm it is built to execute. Some classes of processors are distinguished where the classes correspond in general to the application area, rather than to the architecture or design philosophy. Some general points on the applications and motivations of hardware processes are developed. The example covers the Fast Fourier Transform Processors and hardware for track recognition in high-energy physics experiments. The emphasis is on processors for wire chamber data, and a survey is made of special hardware for filtering of digitized coordinates from bubble chamber film. Processes designed and built for track-recognition in a spectrometer set-up using proportional wire chambers are described. (58 references) (MCW)

35659 (CERN-74-23, pp 263-270) FUTURE DEVELOPMENTS IN COMPUTER ARCHITECTURE AS A RESULT OF IMPACT OF THE MICROCOMPUTER TECHNOLOGY. Monrad-Krohn, L. (Norsk Data Industry, Oslo). 15 Nov 1974.

In proceedings of the 1974 CERN school of computing, Godoeysund, Norway, 11–24 August 1974.

The impact of microcomputers on the computing science as a whole will not be great. In the specific area of computer architecture there will be several trends that can be compared to the transition from transistor logic to integrated circuits. The emergence of the microcomputer will stir further development in language theory, as a need for expressing algorithms for parallel processing is a key point to the effective utilization of the microcomputer as a mass product. (auth)

35660 (CERN-74-23, pp 394-401) SOFTWARE ENGINEERING. Buxton, J. N. (Univ. of Warwick, Coventry, Eng.). 15 Nov 1974.

In proceedings of the 1974 CERN school of computing, Godoeysund, Norway, 11–24 August 1974.

The present state of software engineering in the computer industry is that software is late, expensive, unreliable, and does not work to specification, indicating that a software crisis exists. A characterization of the main lines of software design and construction are discussed under three topics: cottage industry, heavy engineering, and applied logic approaches. Other topics covered include systems design, design methodology, and a chief programmer team. The magnitude of the software costs in the USA are discussed and indicate that the development cost of OS 360 to the year 1969 was about two hundred million dollars. (MCW)

35661 (CERN-74-23, pp 402-425) INITIATION TO HYDRA. Boeck, R. K. (CERN, Geneva). 15 Nov 1974.

In proceedings of the 1974 CERN school of computing, Godoeysund, Norway, 11–24 August 1974.

A short introduction to and justification for the HYDRA programming system are given. Calling sequences of user routines and examples are included. The article provides a reference for the casual user of HYDRA. (SFL)

35662 (CERN-74-23, pp 426-433) PROGRAMMING DISCIPLINE. Dahl, O. J. (Univ. of Oslo). 15 Nov 1974.

In proceedings of the 1974 CERN school of computing, Godoeysund, Norway, 11–24 August 1974.

Good programming discipline is to produce programs which are: easy to use and to understand, reliable and easy to debug (if not already correct), and easy to adapt to changes in the environment. In order to fulfill these requirements programs must be well structured and well documented. Research on techniques for program correctness proofs has shed some light on what good structure and adequate documentation is. A program easily proved correct is easy to understand, and vice versa. Programming language features and certain mental techniques are aides to produce well structured programs. Discipline is required to obtain good documentation. The latter is even more important. (auth)

35663 (ORNL-RSIC-38(Vol.2)) TECHNIQUES FOR EFFICIENT MONTE CARLO SIMULATION. Volume II. Random Number Generation for Selected Probability Distributions. McGrath, E. J.; Irving, D. C. (Oak Ridge National Lab., Tenn. (USA)). Apr 1975. Contract W-7405-eng-26. 130p. (SAI-72-590-LJ). Dep. NTIS $9.50.

Algorithms for efficient generation of random numbers from various probability distributions are presented, in both a flowchart form and as a sample Fortran subroutine. Twenty-two different distributions, including all commonly encountered discrete and continuous functions, the Weibull, Johnson, and Pearson families of empirical distributions, and histogram distributions, are covered. The general techniques to apply in deriving a random number selection scheme for an arbitrary distribution are discussed. A machine-independent subroutine for generating uniform random numbers is also described. (auth)

35664 (RL-74-143) COMPUTING AND AUTOMATION DIVISION QUARTERLY REPORT, 1 JULY 1974–29 SEPTEMBER 1974. Walkinshaw, W.; Lea, A. T. (eds). (Science Research Council, Chilton (UK). Rutherford Lab.). Nov 1974. 32p. Dep. NTIS (US Sales Only) $4.75.

Proposals to upgrade four tape drives to quadrupole density (6250 bpi), to upgrade six disc drives to double density (200 Megabytes), and to upgrade the workstations at CERN, Oxford, Imperial College and Durham with 4800 bps lines and faster printers are being supported. Performance was marred by a logic problem with the Block Multiplexor Channel (2880) and a series of crashes on the 3330 disk drives. A workload analysis is given. (MCW)

35665 (SAND-75-5184) SOLVING NON-STIFF ORDINARY DIFFERENTIAL EQUATIONS: THE STATE OF THE ART. Shampine, L. F.; Watts, H. A.; Davenport, S. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 73p. (CONF-7410107-1). Dep. NTIS $6.75.

From SIAM meeting; Alexandria, Virginia, USA (23 Oct 1974).

High quality codes for the initial value problem for ordinary differential equations to be installed at computer centers are discussed. The characteristics and capabilities of the best software for this problem are delineated. The codes evaluated are readily available, easy to implement at different computing installations, and efficient. Efficiency comparisons are made with respect to storage requirements, overhead costs, and derivative evaluation costs. The performance of the codes when faced with various kinds of difficult problems is described. 21 references. (MCW)

35666 (SAND-75-5271) OPSNAP: AN OPTIMIZING S-PARAMETER NETWORK ANALYSIS PROGRAM. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 17p. (CONF-750328-1). Dep. NTIS $4.00.

From ARFTG meeting; Woburn, Massachusetts, USA (17 Mar 1975).

OPSNAP is a general microwave circuit analysis and optimization program that allows an engineer to describe his circuit in terms of ports rather than nodes, and to get as result both the circuit response and the proper circuit values necessary to achieve a certain optimum. The algorithm used works on S-parameters only; no conversions between S, Y, or Z are done. This allows the program to be extremely general in terms of the topology and types of devices allowed. It is configured to run in an HP 2100/2116 computer having 24K words of core and paper tape and teletype I/O peripherals. It was at one time a Hewelett Packard working tool and has been donated to the ARFTG Users library by H. P. This manual is intended as a guide for the use of the program. The author has no access to the source program or knowledge of the algorithms used to generate the program. Circuits to be analyzed and/or optimized are described in a four-section file. The first section, referred to as the Interconnection File, describes the topology of the circuit. The second file, called the Parameter File, describes the components that make up the

circuit (resistors, capacitors, transmission lines, etc.). The third, called the Frequency-Device File, contains the frequency points and the device data. The last contains optimization parameters. The program accepts lumped circuit elements, distributed circuit elements and circuit elements defined by their S-parameters. OPSNAP can be operated in one of three modes. A fully defined circuit can be analyzed, the operator can interact with the program by entering circuit values via the teletype or the circuit can optimize circuit values to achieve a required overall circuit operation. (auth)

Miscellaneous

35667 (AERE-R-6816(Rev.)) USE OF SURFACE-ACTIVE CHEMICALS IN PUMP-ASHORE SCHEMES AND SUCTION DREDGERS. Biddle, P.; Miles, J. H. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jan 1975. 62p. Dep. NTIS (US Sales Only) $6.25. HMSO £1.50.

Surface-active agents added to mud or silt samples accelerate dewatering and consolidation. Laboratory tests and pilot-scale trials were carried out using mainly Thames "black mud" combined with either a flocculating agent (polyacrylamide PAM) or a protective colloid (sodium carboxymethyl cellulose SCMC). Measurements were made of settling rates, packing densities, rate of loss of water, and increase in bearing strength of mud beds. The effects of salinity, origin of mud or silt, ionic character of PAM, and variation in mud concentration on settling rates were determined. (There are however major discrepancies between this work and some later results in AERE-R 7907 which have not been cleared up, but may be due to differences in the mud samples used.) It was found that whereas SCMC has little effect, PAM accelerates dewatering and consolidation in the early stages. For application to pump ashore schemes, the consolidation will need to be studied on a large scale over a much longer period (years). In suction dredging the benefit would be in increasing the payload by increasing the density of spoil in the dredger, but flocculant requirements are high in concentrated mud suspensions, and the figures in this work suggest that it is not economic. Recommendations are made for further work on the pump-ashore application, starting with a field trial and including soil mechanics studies. No further work is envisaged on the suction-dredger application. (auth)

35668 (AERE-R-7907) EFFECT OF POLYACRYLAMIDE ON THE SETTLING OF THAMES MUD. Biddle, P.; Healy, T. V.; McKay, H. A. C. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jan 1975. 34p. Dep. NTIS (US Sales Only) $4.75. HMSO £1.00.

Laboratory studies were made of the settling of Thames mud in 20% seawater, with and without added PAM (polyacrylamide). Besides small-scale tests in 100-ml measuring cylinders, experiments were also made in columns several feet long. It was found that initial settling rates were greatly increased by addition of PAM, provided the mud suspension was only mildly agitated before settling; otherwise the PAM had no effect. Dewatering of a consolidating mud, and the bearing strength for a given degree of dewatering, were also increased by PAM. A striking feature in many of the experiments reported was channeled flow in both upward and downward directions during settling. (auth)

35669 (BARC-749) SPECTROGRAPHIC DETERMINATION OF TRACE METALS IN ATMOSPHERIC PARTICULATES. Krishnamurty, G.; Saraswathy, K. M.; Thomas, O. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.). 1974. 24p. Dep. NTIS (US Sales Only) $4.25.

An emission spectrographic method is described for the quantitative estimation of trace metals Mn, Pb, Cr, Ni, V, Cd, Fe, As, and Zn in atmospheric particulates in the concentration range 1 to 1000 ppm. In this method air is aspirated through a Whatman No. 41 filter paper using a high volume air sampler. The filter paper sample is converted to carbon residue by wet ashing technique. The sample is made up to 100 mg by adding pure conducting graphite. A 25-mg sample is excited in a 10 amp dc arc and the spectra are recorded on Hilger large quartz spectrograph. Germanium is used as an internal standard. The mean standard deviation for various elements varies from 9 to 19%. (auth)

35670 (ORNL-5008) ORNL TOBACCO SMOKE RESEARCH PROGRAM SUMMARY REPORT. Guerin, M. R.; Nettesheim, P. (Oak Ridge National Lab., Tenn. (USA)). Mar 1975. Contract W-7405-eng-26. 95p. Dep. NTIS $5.45.

This research program consists of three projects: The Tobacco Smoke Chemistry Project is sponsored by the Smoking and Health Program of the National Cancer Institute (NCI) to provide analytical chemical support for its core activity of identifying the characteristics of a less hazardous cigarette; the Tobacco Smoke Bioassay Research Project is sponsored by the NCI Smoking and Health Program to develop methodologies for the bioassay of whole smoke, using respiratory tract epithelium; and the Smoke Exposure System Characterization Project, is sponsored by the Council for Tobacco Research-USA (CTR-USA) to develop protocols and analytical methods for objective evaluation of devices designed to expose animals to whole smoke. (CH)

35671 (RT/PROT-(74)27) METEOROLOGICAL MEASUREMENT OF THE LOW LEVELS AND ITS INTERPRETATION IN THE STUDY OF THE DIFFUSIVITY OF THE ATMOSPHERE AT THE BRASIMONE SITE. Winter Season. Cagnetti, P.; Palmieri, S.; Simonini, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Nov 1974. 54p. (In Italian). Dep. NTIS (US Sales Only) $5.75.

For the period 1972–1973, it was decided to carry out four series of meteorological measurements, one for each season, with the aim of characterizing the Brasimone site (Appennino Tosco-Emiliano) from the atmospheric diffusion point of view. The data collected during the soundings carried out in the winter period are reported. After a description of the meteorological situation of the period under consideration (8–14 January 1973) temperature and wind data were studied both to make an evaluation of the local effects on the diffusion over short range, and to obtain some information about the meso-scale circulation. (tr-auth)

Chemistry

35672 (BARC-747) X-RAY FLUORESCENCE METHOD FOR THE DETERMINATION OF As AND Zn IN TIN OXIDE. Dixit, R. M.; Kapoor, S. K. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.). 1974. 14p. Dep. NTIS (US Sales Only) $4.00.

Arsenic and zinc in tin oxide were determined in the range of 10 to 1000 ppM by an x-ray fluorescence method. Tin oxide sample is pressed in the form of a double layer pellet and the analysis is carried out by using Philips PW-1220 x-ray spectrometer. The average precision and accuracy of the method is within ±15% in Pb free tin oxide samples. A correction procedure for determining arsenic in tin oxide even in the presence of 100 to 500 ppM of Pb is suggested. (auth)

35673 (BMFT-FB-T–74-09(1), pp 41) APPLICATION OF AUGER ELECTRON SPECTROSCOPY TO ELECTRON PROBE MICROANALYSIS. Weber, U. May 1974. (In German).

22 figs.; 3 tabs.; 17 refs.

In basic research in the field on scanning electron-microscopy. P. 1.

In order to study the analytic possibilities of Auger electron spectroscopy for scanning electron microscopy, an experimental apparatus with a two-grid retarding potential spectrometer was constructed. The intensity of the characteristic electron lines of several chemical elements versus the exciting primary beam current were determined. Measurements in conjunction with the signal-to-background ratio allow the calculation of the detection limit for chemical elements. Further, the object resolution of a scanning image that can be theoretically obtained with characteristic Auger electron signals has been estimated. (auth)

35674 (CEA-CONF-2904) EXAMPLE OF NITRIC ACID RECOVERY BY SOLVENT EXTRACTION. Demarthe, J. M.; Tarnero, M.; Miquel, P.; Goumondy, J. P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Genie Radioactif). [nd]. 31p. (CONF-740917-6). Dep. NTIS (US Sales Only) $4.75.

From international solvent extraction conference; Lyon, France (8 Sep 1974).

A process for the recovery of nitric acid by solvent extraction from nickel sulfate solutions containing this acid is described. The solvent is TBP 50%-dodecane. The process includes one extraction, and two strippings, producing HNO_3 1.5 N and HNO_3 3 to 5 N. Bench-scale tests, with mixer settlers, pilot tests with pulsed columns, and an asymmetric rotating disc contactor (ARDC-Luwa) have shown that the cost of solvent losses is less than 0.02 F/kg of nickel. (auth)

35675 (LBL-3500) INTERFEROMETRY OF ELECTROCHEMICAL MASS TRANSFER BOUNDARY LAYERS. McLarnon, F. R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Dec 1974. Contract W-7405-ENG-48. 310p. Dep. NTIS $18.50.

Thesis.

A travelling, double-beam interferometer was used to study the development of electrochemical mass transfer boundary layers along horizontal electrodes in a rectangular duct. The interferometric fringe patterns (interferograms) of refractive-index fields formed by constant-current Cu deposition from 0.1 M $CuSO_4$ were converted to $CuSO_4$ concentration profiles. Investiga-

tions of the concentration boundary layers in laminar flow at downward-facing and upward-facing electrodes revealed the expected two modes of mass transfer control: forced convention and combined free and forced convection, respectively. Transient and steady-state boundary layer thicknesses and interfacial concentrations for laminar forced convection derived from interferograms show good agreement with asymptotic solutions to the convective diffusion equation. Onset of natural convection effects is correlated with a critical Rayleigh Number. A comparative study of turbulent forced convection boundary layers demonstrates the practicality of increasing mass transfer rates by using small obstacles on the surface to promote local turbulence in an otherwise laminar stream. (MCW)

35676 (UCRL-51752) REACTIONS OF LANTHANON SESQUIOXIDES WITH DIVALENT EUROPIUM OXIDE BY VAPOR–PHASE TRANSPORT. Catalano, E.; Boo, W. O. J.; McCoy, D. D.; Gutmacher, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 26 Feb 1975. Contract W-7405-Eng-48. 27p. Dep. NTIS $4.00.

Reactions between solid pieces of Ln_2O_3 (where Ln = Sm, Gd, Dy, Ho, Er, Tm, Yb, and Lu) and EuO were carried out in Mo capsules at 1500°C via vapor-phase transport. The products of the reactions were sectioned and then examined using optical microscope, x-ray powder diffraction, and electron microprobe techniques. Based on these examinations, it is concluded that binary compounds and/or solid solutions of orthorhombic structure, which (to first-order approximation) are isostructural to Eu_3O_4, are the general products of these reactions. Solid solutions of EuO in Ln_2O_3 and of Ln_2O_3 in EuO also appear to be general reaction products. (auth)

Life Sciences

35677 (ANL-8132) ARGONNE NATIONAL LABORATORY COMPUTERIZED MEDICAL SYSTEM. Long, A. B.; Strehl, F. W.; Van Dolah, B. M. (Argonne National Lab., Ill. (USA)). Oct 1974. Contract W-31-109-Eng-38. 149p. Dep. NTIS $5.45.

The Computerized Medical System (CMS) provides basic support for the Occupational Health Maintenance programs operated by the Health Division of Argonne National Laboratory. This system automatically schedules employees for examinations (based upon their individual health and work requirements), monitors the course of these examinations to ensure that they are completed, and then generates a standardized medical report summarizing the employee's total medical record and flagging abnormal results. Based upon these results, the physician may notify the CMS of additional tests or examinations to be scheduled, thus initiating another cycle. The foundation of the CMS is a highly flexible data base in which is stored all employee medical records. This data base may be searched for generalized information to aid in the formulation and evaluation of Health Division programs. (auth)

35678 (BNL-50418, pp 17-22) TUMOR ANTIGENS IN THE TUMOR-HOST RELATIONSHIP. Smith, R. T. (Univ. of Florida, Gainesville). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

35679 (BNL-50418, pp 30-51) IMMUNOLOGICAL DEFICIENCY STATES AND MALIGNANCY. Cottier, H. (Univ., Bern); Hess, M. W.; Keller, H. U.; Lusciett, P.; Sordat, B. 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

35680 (BNL-50418, pp 52-59) CONCOMITANT TUMOR IMMUNITY. Gershon, R. K. (Yale Univ., New Haven). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

35681 (BNL-50418, pp 60-74) IMMUNOSELECTION OF TUMORS. Zimmermann, A.; Roos, B.; Hess, M. W.; Cottier, H.; Bertschmann M. (Univ., Bern). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

35682 (BNL-50418, pp 272-281) TRANSFER FACTOR IN THE IMMUNOTHERAPY OF CANCER. Valentine, F. T. (New York Univ., NY). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

35683 (BNL-50418, 323-326) ADOPTIVE IMMUNOTHERAPY IN PRIMARY OSTEOSARCOMA: AN INTERIM REPORT. Neff, J. R.; Enneking, W. F. (Univ. of Florida, Gainesville). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

35684 (BNL-50418, pp 327-342) BLAST TRANSFORMATION OF LYMPHOCYTES FROM OSTEOSARCOMA PATIENTS DURING IMMUNOTHERAPY: A PRELIMINARY REPORT. Gainor, B. J.; Enneking, W. F. (Univ. of Florida, Gainesville). 1974.

From interaction of radiation and host immune defense mechanisms of malignancy conference; White Sulphur Springs, West Virginia, USA (23 Mar 1974).

In interaction of radiation and host immune defense mechanisms in malignancy.

35685 (CONF-750319-1) ANALYTICAL SYSTEM FOR THE RAPID SEPARATION OF TISSUE NUCLEOTIDES AT LOW PRESSURES ON CONVENTIONAL ANION EXCHANGERS. Khym, J. X. (Oak Ridge National Lab., Tenn. (USA)). 1975. 41p. Dep. NTIS $5.25.

From 7th annual symposium on advanced analytical concepts for the clinical laboratory; Oak Ridge, Tennessee, USA (13 Mar 1975).

An analytical anion-exchange procedure has been developed for the rapid separation of acid-soluble nucleotides (the so-called free or tissue nucleotides). It permits assay at low pressures (40 to 60 psi) in less than 1 h on 10-cm columns of Aminex resins (conventional styrene-type anion exchangers) with alkaline citrate solutions as the eluent. Separation parameters were investigated to determine optimum conditions for the routine analyses of samples containing tissue nucleotides. Also described here is a simple solvent extraction procedure to remove $HClO_4$ or CCl_3CO_2H quantitatively from cell extracts containing acid-soluble nucleotides. This procedure involves the removal of aqueous acid solutions with a water-insoluble amine dissolved in a water-immiscible solvent. (auth)

35686 (CONF-750428-1) SOME OBSERVATIONS ON PESTICIDE USES IN PUERTO RICO AND OTHER TROPICAL AREAS: A RESEARCH PROSPECTUS FOR PESTICIDE TECHNOLOGY. Block, A. McB.; Brown, R. A.; Ferguson, F. F. (Puerto Rico Nuclear Center, San Juan). 1975. Contract AT(40-1)-1833. 9p. Dep. NTIS $4.00.

From symposium on trends in pesticide research; Liverpool, UK (3 Mar 1975).

The value of non-chlorinated pesticides for use in tropical regions is discussed. The impact of new pesticides on agriculture and public health in tropical regions is emphasized. (CH)

35687 (COO-2003-25) NUTRIENT ENRICHMENT AND EUTROPHICATION OF LAKE MICHIGAN. Progress Report, November 1, 1971–June 30, 1975. Schelske, C. L. (Michigan Univ., Ann Arbor (USA). Great Lakes Research Div.). 1975. Contract AT(11-1)-2003. 19p. Dep. NTIS $4.00.

An experimental technique is described that was developed to study the effect of nutrients on natural phytoplankton communities. The method was used in studies of nutrient enrichment in Lake Michigan. (CH)

35688 (COO-2472-1) STUDY OF MATHEMATICAL MODELS OF MUTATION AND SELECTION IN MULTI-LOCUS SYSTEMS. Annual Progress Report, April 1, 1974–March 31, 1975. (Harvard Univ., Cambridge, Mass. (USA)). 1975. Contract AT(11-1)-2472. 9p. Dep. NTIS $4.00.

Findings of this year's work include: linkage materially affects the gene frequency clines that result from a cline in selection; migration and gene flow produces substantial linkage disequilibrium; there is a significant time lag in the response of populations to gene migration so that equilibration under migration is very slow; in a fluctuating environment with selection for an intermediate optimum, selection will favor loss of variance unless fluctuation is large; large amounts of genetic variation can be held by recurrent mutation with optimizing selection; and under a broad variety of conditions, selection on quantitative characters selects a population distribution of phenotypes that maximizes mean fitness. (auth)

35689 (COO-3085-38) HORMONAL REGULATION OF ENZYME SYNTHESIS IN DIFFERENTIATING MAMMALIAN TISSUES. Greengard, O. (Harvard Medical School, Boston, Mass. (USA); New England Deaconess Hospital, Boston, Mass. (USA). Cancer Research Inst.). 1974. 8p. Dep. NTIS $4.00.

Studies in the last few years have been aimed at establishing correlations between endocrine changes and the maturation of enzyme patterns in the liver of fetal and young postnatal rats. So far, three hormones, glucocorticoid, thyroxine, and glucagon, have been identified which are responsible for promoting the synthesis of specific groups of enzymes at well defined stages of development. The present paper describes the general approach employed in such studies, discusses the implication of the results to mechanisms involved in selective gene expression during differentiation, and illustrates some difficulties which arise in investigating developmental enzyme formation in organs other than liver. (auth)

35690 (COO-3233-3) SOME ASPECTS OF THE MECHANISM OF BACTERIOPHAGE FUNCTION. Progress Report, February 21, 1974-February 10, 1975. Freifelder, D. (Brandeis Univ., Waltham, Mass. (USA)). 1975. Contract AT(11-1)-3233. 7p. Dep. NTIS $4.00.

We have been concerned with replication, recombination, and maturation of E. coli phage λ. New techniques have been developed for isolating replication and recombination intermediates. The λ red gene has been shown to be able to substitute for the E. coli recBc gene in recombination repair. Recombination- and replication-deficient double mutants of λ are incapable of lysogenization. This capability is restored by mutating the bacterial recL gene. Several new recombination-deficient mutants of E. coli have been isolated; these have phenotypes not reported before. Termination of replication of bidirectionally replicating λ DNA is by collision of the growing forks. (auth)

35691 (FMI-1000-588) LYSOSOMAL AND NEUTRAL HYDROLASE ACTIVITY DURING THE REGRESSION OF CARDIAC HYPERTROPHY. Cutilleta, A. F.; Reddy, M. K.; Dowell, R. T.; Zak, R.; Rabinowitz, M. (Chicago Univ., Ill. (USA). Dept. of Medicine). [nd]. 14p. (CONF-7309136-1). Dep. NTIS $4.00.

From meeting of myocardiology cell damage; Freiburg, F. R. Germany (Sep 1973).

Cardiac hypertrophy was produced in rats by constriction of ascending aorta. Removal of the constricting band 10 days after operation results in rapid decline in LV weight and total ventricular RNA. Activities of acid RNase and β-glucuronidase were elevated 3 days after aortic constriction. Activities of cathepsin D and alkaline RNase were unchanged. Activities of cathepsin D and acid RNase were unchanged 1 and 3 days after removal of constricting band. Ca^{2+} activated, neutral protease (CAF) isolated from postmitochondrial muscle supernatant was partially purified and characterized. CAF specifically degraded α-actinin when incubated with isolated myofibrils in the presence of Ca^{2+}. (auth)

35692 (FMI-1000-590) PURIFICATION AND PROPERTIES OF ERYTHROPOIETIN: A CRITICAL REVIEW. Goldwasser, E. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). [nd]. 18p. (CONF-740850-1). Dep. NTIS $4.00.

From international symposium on erythropoiesis; Tokyo, Japan (21 Aug 1974).

A brief, critical review of the data pertaining to the purification, criteria for homogeneity, physical and chemical properties, and structural requirements for biological activity of erythropoietin is presented. (auth)

35693 (LBL-3679) ROLE OF MANGANESE IN PHOTOSYNTHETIC OXYGEN EVOLUTION. Blankenship, R. E. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jan 1975. Contract W-7405-eng-48. 137p. Dep. NTIS $10.00.

Thesis.

The mechanism of oxygen evolution remains one of the most interesting and yet one of the least understood aspects of photosynthetic energy storage. Manganese has long been associated with the O_2 evolving step of photosynthesis. It has been postulated that manganese stores oxidizing equivalents generated by Photosystem II until four have been accumulated, at which time oxygen is quickly produced from water. Evidence concerning the role and environment of chloroplast manganese is reviewed. (CH)

35694 (ORNL-5016, pp 37-38) ECOLOGICAL ANALYSES AND APPLICATIONS. Dinger, B. E.; Abbott, T. M.; Adams, S. M. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

35695 (ORNL-5016, pp 73-74) FOREST MANAGEMENT. Bradburn, D. M.; Raby, H. F.; Rosenbalm, E. H. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

35696 (ORNL-5016, pp 75-80) WALKER BRANCH WATERSHED: A STUDY OF TERRESTRIAL AND AQUATIC SYSTEM INTERACTIONS. Henderson, G. S.; Anderson, R. M.; Anderson, S. H. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

35697 (ORNL-5016, pp 94-102) TOXIC MATERIALS IN THE ENVIRONMENT. Van Hook, R. I.; Allen, C. P.; Andren, A. W. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

35698 (ORNL-5016, pp 115-116) ANALYSIS AND EVALUATION OF ECOLOGICAL DATA. Burgess, R. L.; Anderson, R. M.; Goff, F. G. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

35699 (ORNL-5016, pp 117-124) EASTERN DECIDUOUS FOREST BIOME. Burgess, R. L.; Booth, R. A.; DeAngelis, D. L. Mar 1975.

In Environmental Sciences Division annual progress report for period ending September 30, 1974.

35700 (ORO-4023-6) STUDIES OF DROSOPHILA DISPERSAL AND SPECIES PACKING. Progress Report. Richardson, R. H. (Texas Univ., Austin (USA). Dept. of Zoology). 1 Apr 1975. Contract AT(40-1)-4023. 19p. Dep. NTIS $4.00.

The dispersal behavior of eight Drosophila species was recorded. Although directed at the ecological and behavioral aspects of dispersal, the genetic implications of dispersal have been stressed. The following views concerning Drosophila dispersal have emerged: correct estimation of dispersal rate depends upon a study population unmodified by study conditions; dispersal rates expected for a given species are a property of the predicability of the larval and adult substrates; within a species, nutritional or temperature-humidity stress increases dispersal rates; and wind modifies the distribution of migrants. (ERB)

35701 (RLO-2225-T23-4) RESPONSE OF DAPHNIA POPULATION SIZE AND AGE STRUCTURE TO PREDATION. Hairston, N. G. Jr.; Pastorok, R. A. (Washington Univ., Seattle (USA). Dept. of Zoology). 1974. Contract AT(45-1)-2225. 17p. (CONF-740826-5). Dep. NTIS $4.00.

From International Association of Limnology meeting; Winnipeg, Canada (22 Aug 1974).

The cascade model of size-selective predation was used to study both vertebrate and invertebrate predation on a population of Daphnia under a wide variety of situations in an aquatic ecosystem. (auth)

35702 (SAND-75-0052) DRY HEAT INDUCTION OF AUXOTROPHIC MUTANTS IN BACILLUS SUBTILIS VAR. NIGER SPORES: A PRELIMINARY REPORT. Dillon, R. T.; Conley, M. B. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1975. Contract AT(29-1)-789. 21p. Dep. NTIS $4.25.

Auxotrophic mutations were induced in dry Bacillus subtilis var. niger spores by varying times of heat treatment at 115°C and 125°C. The percentage of auxotrophic mutants among the survivors decreases after an initial increase. No particular pattern of auxotrophy was observed among the mutations. (auth)

35703 (UCRL-76557) MONODISPERSE CELL SAMPLES: THE PROBLEM AND POSSIBLE SOLUTIONS. Mayall, B. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 25 Feb 1975. 18p. (CONF-750415-1). Dep. NTIS $4.00.

From international conference on automation of uterine cancer cytology; Chicago, Illinois, USA (7 Apr 1975).

Automated cytological procedures are severely hampered by the presence of cell clusters and tissue fragments. This is usually the case with gynecologic speciments. The preparation of monodisperse cell samples represents a compromise between the need for single cells and the need for cytological preservation. A method for preparing samples for machine analysis is suggested. It includes: fixation; chemical dispersion; mechanical dispersion; specimen enrichment; slide preparation; and straining. The first four steps of the process are discussed. (ERB)

35704 EPIDEMIOLOGICAL AND SEROLOGICAL STUDIES OF HOOKWORM INFECTION IN ENDEMIC AREAS IN INDIA AND WEST AFRICA. Schad, G. A. (Univ. of Pennsylvania, Philadelphia); Soulsby, E. J. L.; Chowdhury, A. B.; Gilles, H. M. pp 41-54 of Nuclear Techniques in Helminthology Research. Vienna; International Atomic Energy Agency (1975).

From proceedings on the use of nuclear techniques in research and control of helminthic infections; Nairobi, Kenya (26 Nov 1973). See STI/PUB-390; CONF-731167-.

A discordant relationship between a high prevalence and a moderate mean density of hookworms in man suggested that in

Gangetic West Bengal, the hookworm population was naturally controlled. Factors contributing to the regulatory process were investigated over a 20-year period. Ecological investigations showed that infective larvae do not survive the inter-monsoon period, November to June, and that during the monsoon season such larvae would be contacted usually individually or in small groups. The density of adult worms in man varies seasonally. Two longitudinal investigations, conducted in parallel, showed that the egg counts of both a large sample of children and of a group involving all age classes declined sharply beginning late in the monsoon season and that this decrease continued into February. Some age-cohorts were net losers of worms in some years. Egg counts increase with age through adolescence, but level off in adult males and, in fact, decline in adult females. They increase again in the aged. Changing rates of exposure do not account for the failure of egg counts to continue to increase throughout adulthood. Thus, the populations of adult worms in man are controlled to densities below those expected by seasonal loss in all ages, by a net loss with age in adult females and by establishment of an equilibrium in males, where gain and loss of worms occur at equal rates. It is suggested that, given the constellation of ecological and behavioral factors characteristic of West Bengal, the average villager is exposed to periodic, small larval invasions, and that this regimen exposure may provide the basis for resistance and regulation of the hookworm population. Gel diffusion precipitation and indirect haemagglutination tests were carried out on sera of individuals aged from 6 months to 60 years in a Necator americanus endemic area. Children younger than 24 months showed either no, or a low, antibody response to hookworm antigen. Adults showed higher antibody response and at times high titres. Some specificity was demonstrated, by absorption studies between the haemagglutin response to N. americanus and A. lumbricoides and between larval and adult hookworms. On electrophoresis, a change in the location of haemagglutins in the serum was noted in patients with hookworm anaemia as compared to normal blood donors. (auth)

35705 STUDIES WITH NECATOR AMERICANUS MAINTAINED IN HAMSTERS. Ogilvie, B. M.; McLaren, D. J.; Worms, M. J. (National Inst. for Medical Research, London). pp 55-60 of Nuclear Techniques in Helminthology Research. Vienna; International Atomic Energy Agency (1975).

From proceedings on the use of nuclear techniques in research and control of helminthic infections; Nairobi, Kenya (26 Nov 1973). See STI/PUB-390; CONF-731167-.

In the last three years we have successfully passaged a strain of Necator americanus for 14 generations in hamsters (Mesocricetus auratus). The first seven passages were in animals treated daily with cortisone beginning when the infected animals were weaned. Hamsters are infected in the first few days after birth since they develop a strong age immunity which makes this model system suitable for studies of certain aspects only of the host-parasite relationship. The morphological development of the worm in the hamster is very similar to that in man, but the majority of the larvae are expelled before the final moult. Approximately 5% of the larvae complete their development and persist for some months as mature worms, with egg production occurring for about the first month after the worms reach maturity. Living fourth stage larvae and adult parasites are required in order to study the antigenicity and immunogenicity of this worm in man and hamsters. Immunity to other parasitic nematodes is stimulated by enzymes secreted from the large glands at the anterior end of the worms. N. americanus possesses three sets, oesophageal, excretory and amphidial glands, all of which contain secretory granules. The oesophageal and excretory glands are similar in structure to those described in other nematodes. The amphidial glands differ in that they are intimately associated with the amphidial sense organs. It is suggested that the secretory activity of the amphidial glands may be under direct nervous control. N. americanus synthesises acetylcholinesterase in its oesophageal and amphidial glands and high levels of this enzyme are secreted by worms maintained in in vitro culture. Proteases are released from the excretory pore. Because acetylcholinesterase is secreted by many other nematodes and stimulates anti-cholinesterase antibodies in their hosts, we are studying the properties of this enzyme in Necator americanus as a marker of the immune response. (auth)

35706 FATE OF LITOMOSOIDES CARINII ADULTS TRANSFERRED INTO INFECTED AND NAIVE MONGOLIAN JIRDS (MERIONES UNGUICULATUS). Weiner, D. J.; Soulsby, E. J. L. (Univ. of Pennsylvania, Philadelphia). pp 85-99 of Nuclear Techniques in Helminthology Research. Vienna; International Atomic Energy Agency (1975).

From proceedings on the use of nuclear techniques in research and control of helminthic infections; Nairobi, Kenya (26 Nov 1973). See STI/PUB-390; CONF-731167-.

Mature L. carinii were transplanted from donor jirds into the pleural cavities of naive, infected and immunized recipients. Rejection of the transplanted worms in the naive and immunized groups took the form of an inflammatory response with fibrosis and death of the worms. Acceptance of the new worm burden in the infected group was characterized by a mixing of the two populations with little or no cellular infiltration. It is postulated that acceptance of adult L. carinii demands a "preparation" period and present evidence indicates this is associated with living parasites in the pleural cavity. (auth)

35707 IMMUNIZATION EXPERIMENTS WITH VARIOUS BOOSTER ANTIGENS AFTER CHEMOTHERAPEUTIC ERADICATION OF SCHISTOSOMA MANSONI IN WHITE MICE. Striebel, H. P.; Sarasin, G. (Ciba-Geigy Ltd., Basel). pp 145-157 of Nuclear Techniques in Helminthology Research. Vienna; International Atomic Energy Agency (1975).

From proceedings on the use of nuclear techniques in research and control of helminthic infections; Nairobi, Kenya (26 Nov 1973). See STI/PUB-390; CONF-731167-.

Attempts were made to stimulate protective immunity to Schistosoma mansoni by subjecting mice to infections with 100 cercariae, lasting for at least 56 and up to 140 days, which where then terminated by chemotherapy. Afterwards immunity was boosted with cercarial, adult or unspecific (BCG) antigen. The development of and changes in circulating antibodies were studied in parallel by immune electrophoresis throughout the duration of the experiments. Evaluation of the results obtained in percutaneously challenged and p. c. immunized and non-immunized mice furnished no evidence of acquired resistance, as revealed by worm counts or by the "stunting" phenomenon. Only in one experiment, in which old mice received the p. c. immunizing infection on the 140th day, was a mean reduction of 40% in the parasite count observed. The serological studies revealed up to 10 specific precipitating antigen-antibody systems in immunized and specifically boosted mice. In the non-specifically (BCG) boosted groups up to 13 precipitating antibodies were found. In an untreated group of infected mice, in which the infection lasted for 20 weeks, 18 antibodies could be detected. After subcutaneous infections, a significant degree of acquired resistance was observed. The protective effect against challenge infections was independent of the number of booster antigen injections and the duration of the immunizing infection (from 56 to 140 days). It may be concluded that neither somatic cercarial schistosomular or adult antigens nor secretory/excretory schistosomular or adult antigens (exo-antigens) are essentially involved in the stimulation of resistance in mice. The results of our experiments rather indicate that cercarial exo-antigens may be essential for conferring protective immunity on mice. (auth)

Materials

35708 (CEA-CONF-2779) STUDY OF THE OLIGOCYCLIC FATIGUE OF A 316 L STEEL. Brun, G.; Gauthier, J. P.; Petrequin, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Technologie). 1974. 33p. (In French). INIS.

From autumn meeting on metallurgy; Paris, France (30 Sep 1974).

The oligocyclique fatigue of a Z2CND 17-12 type steel was studied at the temperatures 20, 300, 450 and 600°C. The tests were carried out at given deformation, under traction compression at a frequency of 3 cycles per minute. Analysis of the results by standard Coffin laws proved satisfactory. Cyclic hardening was studied from rupture testing and by the application of deformation increments. The under-structures after fatigue were examined by electron microscopy on thin sheets. They are distinguished by special arrangements of dislocations (cells, clusters) and by the presence of sub-grains at high temperatures. At each temperature the average size of the cells decreases as the strain corresponding to the stable cycle rises. The present results are satisfactorily interpreted by means of an expression of the form $d\alpha^{-p}$ with p about 2 at 600°C and 0.5 at room temperature respectively. (FR)

35709 (CEA-CONF-2831) DECHANNELING OF PARTICLES BY LATTICE DEFECTS. Quere, Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Section d'Etude des Solides Irradies). 1974. 17p. (CONF-7309135-1). Dep. NTIS (US Sales Only) $4.00.

From international summer school on boundary problems between nuclear and solid state physics; Predeal, Romania (6 Sep 1973).

It is first shown that dechanneling of particles by lattice defects can be due to an obstruction effect (typical example : stacking fault), or to the deformation of the lattice (typical example : dislocations) or to both effects occurring simultaneously (typical examples : defect-clusters, Guinier-Preston zones...). Calculations of the corresponding dechanneling cross sections are

presented. Experimental evidence of dechanneling are described for such defects as 1/ grain - (or twin-) boundaries, 2/ stacking faults, 3/ dislocations, 4/ interstitial atoms, 5/ radiation-induced defects, 6/ gas bubbles, 7/ G.P. zones, 8/ order anti-phase boundaries. Dechanneling cross sections have been measured accurately in cases 1/ 2/ 3/ 4/. The experimental values are in very satisfactory agreement with the theoretical ones. For example, the dechanneling width of a straight dislocation, in aluminium, for α particles (5 MeV) channeled along $\langle 111 \rangle$ planes is found equal to 140 ± 40 Å, whereas calculation gives 175 Å. (auth)

35710 (COO-3166-16) ENVIRONMENT AND FRACTURE. Technical Progress Report. Johnson, H. H. (Cornell Univ., Ithaca, N. Y. (USA). Materials Science Center). 6 Mar 1975. Contract AT(11-1)-3166. 14p. Dep. NTIS $4.00.

A study of hydrogen transport through zone-refined iron from 0 to 550°C was completed, using electrochemical and gas phase charging, and vacuum and electrochemical flux measuring techniques. Transient measurements on annealed iron show hydrogen trapping below 350°C; transmission microscopy studies are underway to correlate trapping parameters with dislocation structure. The trapping parameters are consistent with traps which hydrogen saturates, rather than voids which would not be expected to show saturation behavior. Steady state flux measurements show no anomalies in lattice hydrogen solubility and diffusivity over 0°C to 550°C. A comparative study of deuterium and hydrogen permeation through iron is nearly complete. Non-classical isotope ratios of 1.7 to 1.9 are measured over 0 to 75°C, but at higher temperatures there is a tendency to the classical square root of mass or 1.41 dependence. (auth)

35711 (UCRL-76541) PATTERN RECOGNITION FOR UNDERSTANDING AND MODELING MATERIALS PROBLEMS. Bender, C. F.; Carlson, L. R.; Pritchard, R. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Feb 1975. 22p. (CONF-750330-1). Dep. NTIS $4.25.

From 26th Pittsburgh conference on analytical chemistry and applied spectroscopy; Cleveland, Ohio, USA (3 Mar 1975).

Interactive and iterative use of pattern recognition techniques are presented to solve a number of materials problems, including a simple chemical example and a complicated production problem. (auth)

Physics and Engineering

35712 BMFT-FB-T-74-09(2), pp 18) ON THE SCANNING ELECTRON-MICROSCOPY OF THIN SPECIMENS IN TRANSMISSION. Herrmann, K. H. May 1974. (In German).

5 figs.

In basic research in the field of scanning electron-microscopy. P. 2.

For testing the possibilities of the electron microscopy with scanning methods, two ways have been proved. After the successful work of A. Crewe of the University of Chicago with his high resolution scanning-transmission microscope, we tested systems with field-emission guns. This work shows that a treating of the field emission gun with oxygen increases the brightness of the system. On the other hand, we are now going into the construction of a gun system for a transmission microscope which will operate at 100 kV. As a second way for doing scanning-microscopy we tried using an Elmiskope 101. Here we could achieve a resolution of about 3 nm. In the instrument there was built-in an energy-analyzer, which allows to get analytical informations of the specimen by measuring the plasmon losses of the irradiated area. (auth)

35713 (CEA-CONF-2748) STUDIES OF SUBLIMATION USING A DIFFERENTIAL SCANNING CALORIMETRY METHOD. Couach, M.; Bonjour, E.; Simatos, D. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Jul 1974. 13p. (CONF-740745-1). Dep. NTIS (US Sales Only) $4.00.

From 4th international conference on thermal analysis; Budapest, Hungary (8 Jul 1974).

A method is described to measure the heat of sublimation using a differential scanning calorimeter. The method has been applied to study quantitatively the kinetics of sublimation of ice contained in small capillaries. It is shown that the sublimation is controlled by mass transfer in the vapor phase which is of a molecular flow type until 240 K is reached. Applications of sublimation to plasma solution are given. (auth)

35714 (CEA-R-4584) DIFFUSION LENGTH MEASUREMENTS OF MINORITY CARRIERS IN DEVICES. Carme, H. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). Feb 1975. 49p. (In French). Dep. NTIS (US Sales Only) $5.50.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble, France.

The measurement of the light-induced current in diodes as a function of wavelength was proposed for the first time by Lofersky; this technique allows evaluation simultaneously in a diode of the emitter and base diffusion lengths and the surface recombination velocity. An experimental system is described that allows to obtain an accurate value of the induced current using a small light spot decameter (from 20 and 100 μ). A parameter automatic research program is used for extracting, from the measured efficiency curve, the parameters and the accuracy of each parameter was calculated. The following were obtained: in the case of a usual planar diode, the following parameter junction depth (1,7 ± 0,1 μ), oxide thickness (0,75 ± 0,05 μ) emitter and base diffusion lengths (0,9 ± 0,1 μ and 16,7 ± 2 μ), surface recombination velocity (3 ± 1,2 10^3 cm/sec). In the case of a mesa power double-diffused transistor, the base width (20 μ to 20 %), base diffusion length (23 μ to 20 %), emitter and collector diffusion length (4,1 μ to 10 %), values in agreement with the experimental transistor gain. To conclude, the error charts for the different parameters' values show that this method can be extended to the electrical analysis of various semiconductor devices and is a very good tool for computer aided design devices. (tr-auth)

35715 (CONF-750414-1) RACKING TESTS OF HIGH-RISE BUILDING PARTITIONS. Freeman, S. A. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). 1975. 29p. Dep. NTIS $4.50.

From ASCE national structural engineering convention; New Orleans, Louisiana, USA (14 Apr 1975).

The results of a program of racking tests of wall panels can be incorporated into the analysis of high-rise structures influenced by non-structural partitions. Stiffness and energy-absorbing characteristics were obtained from racking tests of wall panels simulating lateral interstory displacements in high-rise buildings. These characteristics were combined with structural frame periods and damping to estimate overall building periods and damping. Illustrative examples are presented. (auth)

35716 (COO-1248-46) ELECTRICAL CHARGING OF SMALL PARTICLES AT LOW PRESSURES. Progress Report, July 1, 1974-June 30, 1975. Liu, B. Y. H.; Whitby, K. T. (Minnesota Univ., Minneapolis (USA). Dept. of Mechanical Engineering). Mar 1975. Contract AT(11-1)-1248. 10p. Dep. NTIS $4.00.

A series of experiments have been performed on the unipolar diffusion charging of aerosols. Unipolar positive ions produced by a corona discharge were used. The experiments covered a particle size range of 0.006 and 5 μm diameter and an N_0t product of 3×10^6 to 3×10^7 (ions/cc)(sec) where N_0 is the ion concentration and t is the charging time. Data are presented showing the median particle charge as a function of particle size for several different N_0t values. In addition, for particles in the ultrafine particle size range between 0.006 and 0.06 μm, the fraction of particles that are electrically charged following exposure to unipolar positive ions is determined. These data are being compared with the available charging theories. (auth)

35717 (COO-3449-1) TRANSMISSION SECONDARY EMISSION (TSE) MULTIPLIERS USING HIGH-GAIN SECONDARY EMITTERS. Final Report, August 1, 1974-December 31, 1974. Olsen, G. H.; Martinelli, R. U. (RCA Labs., Princeton, N. J. (USA)). Mar 1975. Contract AT(11-1)-3449. 94p. Dep. NTIS $7.75.

A materials study was undertaken to perfect the InGaP/GaAs interface in order to reduce normalized interfacial recombination velocities (s_b) in transmission secondary emission (TSE) devices. As a result, defect-free interfaces were developed which significantly lowered s_b and increased TSE gains. TSE gains as high as 210 at 10 keV and 540 at 20 keV were observed. Such devices exhibited diffusion lengths between 3 and 5 μm, values of s_b between 0 and 0.5, and surface escape probabilities of ~0.15. Techniques were also developed to detect the presence of misfit dislocations via optical microscopy. Growth rates of InGaP as high as 60 μm/h were achieved by increasing the hydrogen carrier gas flow in the VPE reactor. (auth)

35718 (JAERI-M-5567, pp 36-50) CHANNELING PHENOMENA OF HEAVY ION IN CRYSTAL. Ozawa, K. Mar 1974. (In Japanese).

From meeting on atomic energy research with heavy ions; Tokai, Ibaraki, Japan (25 Oct 1973).

In proceedings of meeting on atomic energy research with heavy ions.

The channeling effects of heavy ions in crystal are reviewed on the following four topics: i) the stopping power of heavy ions and the Z_1 oscillations of the electronic stopping power, ii) charge changing collisions of heavy ions channeled in crystal, iii) oscillation frequencies of heavy ions in planner channeling in thin crystals and screening parameters of the interaction potentials and iv) hyper channeling and ion-atom potentials in solids. (auth)

35719 (JINR-P11-8410) CALCULATION OF THE BREMSSTRAHLUNG ENERGY SPECTRUM FROM THE THIN DIAMOND SINGLE CRYSTAL BY THE MONTE CARLO METHOD. Akopov, N. Z.; Ososkov, G. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1974. 13p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The mode of calculation of the bremsstrahlung spectrum from the diamond single crystal is described. The calculation is performed by the Monte-Carlo method allowing for the radiated γ-quanta collimation and the angular divergences of the electron beam. The presented calculation curve and the experimental points are in good agreement. (auth)

35720 (LA-UR-74-1779) ADAPTIVE CONTROL TECHNIQUES FOR ON-AXIS RADARS. Schelonka, E. P. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 7p. (CONF-750417-1). Dep. NTIS $4.00.

From international radar conference; Arlington, Virginia, USA (21 Apr 1975).

Digital data processing incorporating filtering, memory, repetitive prediction, and comparison methods aid in providing smooth accurate tracking within the physical constraints of ON-AXIS radar systems. Dynamic digital filtering is based on trends in rf hits that in turn control the error channel band-width. Differences between predicted and actual target locations are used in making subsequent predictions. Antenna drive is a digital type-II servo loop based on drive signals from the predictor. Methods to optimize system response are discussed and results showing improved performance are given. (auth)

35721 (SAND-75-5132) PORTABLE KERR SYSTEM FOR THE MEASUREMENT OF HIGH VOLTAGE PULSES. Hebner, R. E. Jr.; Booker, S. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 5p. (CONF-750405-1). Dep. NTIS $4.00.

From IEEE southeastcon; Charlotte, North Carolina, USA (7 Apr 1975).

Previous work has demonstrated the utility of the electro-optic Kerr effect for the measurement of high voltage pulses. A novel system, using the Kerr effect, has been constructed and tested. This system is designed to measure microsecond rise-time pulses, having a duration of less than one hundred microseconds and peak values ranging from about five thousand volts to over one hundred thousand volts. The system incorporates a variety of features not found in previous devices. First, the system is truly portable. The approximate dimensions of the system are 12 cm by 12 cm by 45 cm. Within this enclosure are the laser, polarizer, Kerr cell, and photodetector. To detect the output, all that is necessary is to supply power for the laser and photodetector and to attach the voltage to be measured to one set of terminals and an oscilloscope to another. The second interesting characteristic of this system is that it can be used accurately over a wide range of peak voltages (10^3-10^5 V) because it accommodates three different Kerr cells with nominal plate spacings of 0.2, 0.5 and 1.0 cm. The final novel characteristic is that a double-pass optical system was employed. That is, the polarized light beam passes through the Kerr cell, impinges upon a mirror, and is reflected back through the Kerr cell, effectively doubling the length of the cell. This permits good sensitivity in a cell that is physically small and, although cell capacitance does not usually present a problem, it too is reduced as the plate length is reduced. (auth)

35722 (UCRL-51726) MATHEMATICAL THEORY OF MODELING. Corynen, G. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Dec 1974. Contract W-7405-Eng-48. 49p. Dep. NTIS $4.00.

Modeling is probably the most pervasive activity in science and engineering today, and yet there seems to be no satisfactory mathematical theory of modeling as an abstract process and no suitably precise definition of what is meant by modeling. A theory is developed that allows the discussion of a wide variety of modeling problems and which is based on the central concept of model. The study of this concept results in a definition that possesses two essential ingredients: imitation and approximation. The imitation aspects are included by specifying a performance function which extracts from an object the important properties of interest to the modeler. The approximation aspects are incorporated by requiring that a topology be defined that allows the modeler to express the degree to which an object is to possess these properties of interest. An interpretation is required by which the modeler relates performance of the model to performance of the object being modeled. Special attention is directed to properties of the modeling relationship itself that result from the definition. Transitivity of the modeling relationship is investigated, and useful necessary and sufficient conditions for transitivity are established. Indexed classes of objects are discussed and their corresponding models are defined according to the principles that have been developed. Finally, the concept of model extensions is discussed and illustrated with an example on linear vector spaces. (auth)

35723 (UCRL-78618) MEASUREMENT OF FIGURE OF DIAMOND TURNED OPTICS. Saito, T. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Mar 1975. 12p. (CONF-750311-1). Dep. NTIS $4.00.

From workshop on optical fabrication and testing; San Mateo, California, USA (12 Mar 1975).

One of the most serious hurdles for diamond turning to overcome has been obtaining good optical figure. Optical flats have been machined to 1200 Å peak-to-valley flatness over more than 90% of 13 cm diameter mirrors. Optical figure of 3000 Å peak-valley has been obtained on a molybdenum water-cooled flat mirror that was refurbished using diamond turning. Diamond turning lends itself well to the generation of toric optics. Methods and results of measurement of toric optical figure will be presented. (auth)

35724 (UCRL-Trans-10824) HIGH-CAPACITY TARGETS IN X-RAY TUBES. Haubold, H. G. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (F.R. Germany)). 1975. Translated from GSI-75-7. 15p. Dep. NTIS $4.00.

The construction of an x-ray tube to emit the largest possible number of x-ray quanta from the smallest possible focal spot is described. The construction of the target would allow irradiation with 50-keV-electrons of a high beam-current density in continuous operation. A study on the limits of the maximum permissible beam-current density for material selection, requirement for a target able to withstand high loads, and with what maximum heat-flux density can the target surface be loaded without T_{max} being exceeded was made. Experiments on stationary and rotating copper targets were performed and the results depend only on T_{max}, the thermal conductivity, and the specific heat of the copper. The experiment is described and the results may be transferred to targets of other materials. A water-cooled rotating-copper-anode x-ray tube that can be loaded with a continuous power of 100 kW for a focus size of 2×20 mm^2 and a maximum surface temperature of about 280 K was developed. (MCW)

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Recently developed and still rapidly evolving techniques of flow microfluorometry, scanning cytophotometry, and cytographic analysis offer powerful tools for probing the secrets of cell behavior. With these new methods, researchers now can make a more thorough and revealing examination of macromolecular alterations through the faster, less ambiguous measurement of such important parameters as DNA content and distribution, surface receptor sites, cell and nuclear volume, and light scattering. In the interdisciplinary atmosphere of this symposium, physicists, biologists, biophysicists, engineers, and physicians explore the validation, correlation, and application of these analytical techniques to both applied and basic biological problems and discuss how best to exploit the new methods. The 33 papers in this volume are grouped in five sections:

- Image-analysis techniques
- Cell-cycle analysis
- Flow-systems cell analysis and sorting
- The cell nucleus
- The cell surface